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ABSTRACT

The research literature on the preparation of young people for work proves that policy recommendations are based on two false premises--academic skills are good substitutes for occupation-specific skills and increases in job turnover and skill obsolescence rates have caused a decline in the return to occupation-specific training by schools. Analyses provide strong evidence that both generic technical competence and occupation-specific competencies have large effects on worker productivity and other indicators of labor market success. The decline in occupational turnover means the social returns to occupational skills training have increased. The rapid obsolescence of skills implies greater need for occupational skills development, not reduced need. If vocational students learn less mathematics and science than many academic students, it is because they take less demanding, not fewer, academic courses. School-based occupational training produces four effects: within-job productivity, technology-skill transfer, job access, and job stability. Because getting a training-related job is essential for the training to pay off, greater emphasis needs to be given to ensuring that graduates find such employment. The payoff to teaching computer applications is very large. Most high school vocational students could develop their skills more rapidly if their program presented greater challenges and expected more of them. (Includes 12 figures and 18 tables. Appendixes contain 172 references and 38 endnotes.) (YLB)

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CAHRS Center for Advanced Human Resource Studies

Working Paper 95-13

John H. Bishop

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EXPERTISE AND EXCELLENCE

John Bishop
Cornell University
Working Paper # 95-13

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This paper summarizes over a dozen years of research on the preparation of young people for work. Consequently, the work being discussed received support from many sources. Included in the list are grants to Cornell's Program on Youth and Work from the Pew Charitable Trust, grants to the Center on the Educational Quality of the Workforce, agreement number R117Q00011-91, as administered by the Office of Educational Research and Improvement, U.S. Department of Education, grants to the National Center for Research in Vocational Education at Ohio State University from the U.S. Department of Education, grants from Cornell's Center for Advanced Human Resource Studies and by a grant to Cornell from National Association of State Directors of Vocational Technical Education Consortium. The findings and opinions expressed in this report do not reflect the position or policies of the Office of Educational Research and Improvement or the U.S. Department of Education. This paper has not undergone formal review or approval of the faculty of the ILR school. It is intended to make results of research, conferences, and projects available to others interested in human resource management in preliminary form to encourage discussion and suggestions.

EXECUTIVE SUMMARY

"Every man has his own vocation. The talent is the call." Ralph Waldo Emerson penned these famous lines in 1841 at a time when most Americans built their own homes and repaired their own wagons. The statement is even more true for our highly interdependent information society. Knowledge is exploding and new skills emerge every day. We have become completely dependent on the expertise of others.

Because of this dependence, we are willing to pay good wages to people who have skills and expertise that we lack. Rewards for specific skills are determined by the law of supply and demand. Scarce skills tend to be well rewarded. Abundant skills tend to be poorly rewarded. Skills that are new and for which demand is growing tend to receive the highest compensation.

Most of one's educational career is spent learning generic skills such as reading, writing and arithmetic that are in abundant supply. Success in developing these skills does not, however, make one a highly competent worker or ensure a well paid job. As Emerson tells us in another one of his essays: ***"The things taught in colleges and schools are not an education, but a means of education."*** These generic skills are tools for developing the scarcer skills and expertise that determine productivity in particular jobs and which are, therefore, well rewarded by the labor market. **It is unwise to devote one's entire education to learning things that everyone else already knows. One must select a vocation for which there is market demand and for which one has talent and then pursue expertise and excellence within this niche. Expertise and excellence are impossible without specialization.**

If individuals cannot achieve excellence without specialization, an education system that does not accommodate and indeed encourage specialization becomes a barrier to real excellence. People have diverse interests, diverse talents and diverse learning styles. The labor market is similarly diverse in the skills and talents that are sought. A "one size fits all" upper secondary education is bound to fail the majority of students. Our comprehensive secondary schools have historically accommodated this diversity by offering a great variety of courses (including occupation specific courses) and allowing students to select which courses to take.

Where should occupational skills be developed: at a school, on-the-job or in both locations? Should government subsidize schools which offer occupation specific education and training? Some have argued that government should force employers to do more training by scaling back government subsidies of school-based occupationally specific education and training. The Economist (March 12 1994), for example, recently claimed that:

> Economists have long argued that the returns on general education are higher than those on specific training, because education is transferable whereas many skills tend to be job-specific. Today this case is becoming more compelling still as jobs become less secure, the service sector expands and the

life-cycle of vocational skills diminishes and the market puts an even greater premium on the ability to deal with people and process information.

Instead, students should be taught generic academic skills such as reading, writing and mathematics that are useful in all or almost all work places. **These policy recommendations are, however, based on two false premises:**

- **academic skills are good substitutes for occupation specific skills and**
- **increases in job turnover and skill obsolescence rates have caused a decline in the return to occupation specific training by schools.**

The first two parts of the report are devoted to proving these two assertions wrong.

I. Evidence that Occupational Skills are Essential

In most jobs productivity derives directly from social abilities (such as good work habits and people skills) and cognitive skills that are specific to the job, the occupation and the occupational cluster: not from reading, writing and mathematics skills. When employers are asked which skills they look for when hiring, they almost always cite work habits and occupational skills ahead of reading and mathematics skills. The applicants knowledge of history, geography and literature is seldom evaluated.

Global productivity ratings of workers with about 1 year of tenure are strongly related to the employer's ratings of the worker's occupational skills, learning ability, work habits and people skills but are not related to ratings of the worker's academic skills ("reading, writing math and reasoning ability") and leadership.

When paper and pencil tests of occupational knowledge appropriate for the job compete with reading and mathematics tests to predict supervisor ratings of job performance, the job knowledge tests carry all of the explanatory power, the reading and mathematics tests none. When judged performance on a sample of critical job tasks is the measure of job performance, the beta coefficient on the job knowledge test is 2 to 4 times larger than the beta coefficient on a basic skills composite. Thus, basic academic skills make little direct contribution to a worker's productivity. Their contribution is to help the individual learn the occupation and job specific skills that are directly productive. Since large improvements in job knowledge and occupational skills are easier to achieve than equivalent (in proportions of a standard deviation) improvements in verbal and mathematical skills, occupationally specific training is highly desirable if the student is likely to put the knowledge to use by working in the occupation or a closely related one.

Tests assessing technical competence are powerful predictors of wage rates and earnings of young males and highly valid predictors of training success and job performance in technical, craft and industrial occupations. A one population SD increase in technical competence raises the average earnings (regardless of occupation) of young men by $1333. per year in 1985 dollars. Averaging over the six non-clerical non-combat occupations, and assuming that the standard deviation of true productivity is 30 percent of the wage, a one population SD increase in all four of the technical subtests raises productivity by about 11.5

percent of the wage or about $2875. per year in 1985 dollars. With a working life of 40 years and a real discount rate of 5 percent, the present discounted value of such a learning gain is about $50,000. These results imply that broad technical literacy is essential for workers who use and/or maintain equipment that is similar in complexity to that employed in the military.

II. Should Schools or Employers Provide Occupation Specific Training?

Schools have a number of advantages in providing occupational training:

(a) They offer students flexibility in scheduling and the choice of courses,

(b) Hourly costs of training are low because teaching staff are specialized and economies result from spreading the cost of developing courses over many students,

(c) School certification of skills makes them more portable,

(d) Schools and students have access to public subsidies not available to firms, and

(e) Students get to select the occupation for which they will prepare. When firms provide occupational training, competition to enter an occupation occurs before training rather than after.

Employers, on the other, have some important advantages in providing occupational training:

(a') Because selection has proceeded the training, employer training is more likely to be used on a job than training received at a school.

(b') Trainee motivation is likely to be high because promotions and possibly continued tenure depend upon success in training.

(c') Training is generally tutorial in nature and this is known to be an effective mode of teaching. This means, however, that the training is quite costly.

(d') Because the employer is paying the full costs of the training including the time of the trainee, hourly costs are high. The employer also receives most of the benefits of the training. Consequently, the employer has a strong incentive to select efficient and effective teaching methods.

(e') Trainers are often held accountable for how well the trainee learns the job, so incentives are well aligned.

The problem with employer training is not a lack of effectiveness. Per hour spent in training, it is very effective. The problem is the high costs and the consequent insufficient supply. The high social rates of return to employer training that studies have

uncovered are a consequence of under investment. Many of the benefits of training go to individuals who are not a party to the decision to undertake it. It's major beneficiary--the worker--is often poorly informed about costs and benefits and lacks the resources and the access to the capital market necessary to pay for it. Government regulations often get in the way. Because of these barriers, training is undertaken only when it is expected to yield extremely high returns.

If schools were to withdraw from the occupational training market, employers would become the primary provider of occupation specific training. Since separation rates are high, most employers would be unwilling to provide significant amounts of occupational training as long as skill premia remain at current levels. Government could offer employers training subsidies, but such a scheme would be difficult to administer and would probably cost more than the current school-based occupational training system. In the absence of massive subsidies of employer training, shortages of skilled labor would develop and wage premiums for occupational skills formerly learned in school would rise. Lacking immediately useful skills, school leavers would find it more difficult to get work and have to accept lower wage rates. Some employers would substitute less skilled workers for the now more expensive skilled workers. Others would shift activities that require skilled workers overseas. Eventually, the scarcity of skilled workers would become so severe and the wage differential between unskilled and skilled workers so large, that employers would find it has now become profitable to provide occupational skills training. In the new equilibrium, however, the society would have fewer skilled workers, a lower standard of living and a more unequal distribution of earnings.

Rates of turnover and skill obsolescence are now so high, The Economist argues, that occupationally specific skills are no longer good investments for young people. What's wrong with these arguments?

It is the case that job turnover has increased over the last 20 years. On the other hand, occupational turnover has decreased. These two facts do **not** imply that schools should scale back occupational training, leaving this function to employers. **Rather they imply exactly the reverse.** Social returns to occupational training are influenced by occupational turnover, not job turnover. The decline in occupational turnover for men and more recently for women means **the social returns to occupational skills training have increased**. At the same time, **the rise in job turnover has eroded incentives for employers to invest in occupational skills training**. Under investment in occupational training by employers has, therefore, almost certainly increased.

The other part of The Economist's argument is similarly misguided. Yes, skills are becoming obsolete more rapidly, but those who argue that this implies a reduced need for occupation specific skill development have it exactly backwards. Obsolescent skills must be replaced by new skills. **If skills become obsolete more rapidly, then new skills must be learned more frequently. This implies greater needs for occupational skill development, not reduced needs.** If employers cannot be persuaded to increase training, schools must do it. Skill obsolescence is greatest in fast changing fields close to the frontier of knowledge. It is in precisely these fields where the payoff to skill development is the greatest. Yes, the

payoff period is shorter. But it also means that the supply of workers with the new skills is small because previous generations of trainees did not learn them. Thus graduates of training programs which impart the latest skills have something which is scarce and which will, therefore, be well rewarded. The labor market responds to high rates of skill obsolescence by paying a higher premium for the skill.

High rates of skill obsolescence mean, of course, that schools must work hard to keep their training up-to-date. They also imply that workers will need to update their skills continuously.

III. Impacts of Vocational Training on Learning

Vocational training programs have substantial effects on job knowledge. They are less well prepared in academic subjects when they begin their vocational studies and they remain behind during the years they take their vocational courses. Kulik review of the literature concludes that "if vocational students were similar to academic students in aptitude and took the same number of advanced courses in core subjects, the achievement gap would be no more than 0.1 standard deviations (1994, p. 47)."

IV. Impact of School-Based Occupational Training on Productivity and Wages

This Section of the report reviews empirical evidence on how occupational training increases productivity and helps trainees. Four different types of effects are produced.

1. **Within-job productivity effect**: Training raises the trainee's productivity and wage rates (and lowers in-house training costs) in specific jobs. In order for this direct productivity enhancing effect to be realized, the worker's training must have some match with their subsequent jobs.
2. **Technology-skill-transfer effect**: Hiring already trained workers brings knowledge and skills to the firm that in many cases no one currently in the organization or work group has. It helps the firm remain abreast of technological developments. The new employee may be able to teach their unique skill to the firm's other employees.

When training has one or both of these direct productivity enhancing effects, two secondary effects are generated.

3. **Job access effect**: Employers generally prefer to hire workers with relevant training and experience. This is particularly the case when jobs are complex and training is costly. This then results in individuals with training in high-demand occupations getting higher-wage higher-productivity jobs that offer better opportunities for training and advancement.
4. **Job-stability effect**: Occupational training increases commitment to the labor force, lowers turnover and reduces unemployment. Job finding rates are higher because graduates are more marketable. Separation rates are lower because job quality has improved and the worker's skills make layoffs more costly for the firm. Since work experience directly enhances productivity, the job-stability effect has positive long run effects on wages and earnings.

When job is held constant, job relevant training obtained from schools or colleges has important effects on an employee's relative wage rate, relative productivity and the propensity to make suggestions that are adopted. The graduates of private vocational-technical schools and workers sent to off-the-job training by a previous employer are particularly productive and particularly likely to make suggestions. This pattern suggests that productivity impacts are greatest when employers and voc-tech schools collaborate very closely.

When the job is not held constant and representative samples are analyzed, studies find that occupation specific training obtained from postsecondary institutions has large effects on both wage rates and employment. When high school graduates who do not go to college are compared, those who took a sequence of vocational courses in high school do considerably better in the labor market than those who took only academic courses.

V. Policy Implications

Studies have found that getting a training related job is essential for the training to payoff. Indeed, staying in a related occupation for many years appears to magnify the benefits of the occupational training. An analysis of data from the NLS reported in Campbell et al (1987) found that graduates of vocational programs who spent 100% of their work time since high school in a training related job earned 31 percent more than vocational graduates who had never had a training related job. Greater emphasis needs to be given to ensuring that graduates of vocational programs are able to find employment in the occupation for which they have prepared. Apprenticeship programs in which schools and employers share training responsibility is one way to accomplish this.

Another way to increase the usefulness and use of training is for schools to provide incumbent worker training at work site rather than on campus. A number of states are running successful programs of this kind. A third way to increase the use of the training obtained in schools is to assess it and then signal the workers occupational skills to the labor market.

The payoff to teaching workers how to effectively use major computer applications programs like word processing, spreadsheets, Email and data base management are very large. People who use a computer at work are paid 10 percent more per hour than those who do not even when industry and occupation are held constant.

Most high school vocational students could develop their skills more rapidly if their program presented greater challenges and expected more of them. The hiring requirements for entry level blue collar and clerical jobs are increasing. Occupational preparation will inevitably take more time, so programs which track high school vocational students into capstone community college programs in that field are highly desirable.

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EXPERTISE AND EXCELLENCE

Every man has his own vocation. The talent is the call.
--Ralph Waldo Emerson, "Spiritual Laws" Essays: First Series, (1841)

All my life I've always wanted to be somebody.
But I see now I should have been more specific.
Lily Tomlin as Chrissy, by Jane Wagner, 1986 p. 30)

A youngster who does not know what he is good at, will not be sure what he is good for.
--Edgar Z. Friedenberg, The Vanishing Adolescent, (1959)

Ralph Waldo Emerson's comment is even more true of modern information based societies than of the agrarian and industrial societies of Emerson's time. Knowledge is exploding. New skills emerge every day. Automobiles have become so complicated, only professionals have the tools and skills necessary to fix them. **We have become completely dependent on the expertise of others.**

Because of this dependence, we are willing to pay good wages to people who have skills and expertise that we lack. Rewards for specific skills are determined by the law of supply and demand. Scarce skills tend to be well rewarded. Abundant skills tend to be poorly rewarded. Skills that are new and for which demand is growing tend to receive the highest compensation.

Most of one's educational career is spent learning generic skills such as reading, writing and arithmetic that are in abundant supply. Success in developing these skills does not, however, make one a highly competent worker or ensure a well paid job. Rather these generic skills are tools for learning and developing the scarcer skills and expertise that determine productivity in particular jobs and which are, therefore, well rewarded by the labor market. Consequently, **it is unwise to devote one's entire education to learning things that everyone else already knows. One must select a vocation for which there is market demand and for which one has talent and then pursue expertise and excellence within this niche. Expertise and excellence are impossible without specialization.**

This principle applies just as much to the gifted as it does to those with average or

below average learning ability. That is what Ruth Feldman found in her longitudinal study of a group of gifted youngsters, Whatever Happened to the Quiz Kids. Robert J. Sternberg, a leading theorist about intelligence, summarized her findings as follows:

> What is most striking in biography after biography of these quiz kids is that those who were most successful were the ones who found what most interested them and pursued it relentlessly. The less successful among the group had difficulty focussing on any single interest and in a number of cases floundered in the process of carving out a niche for themselves (1988, 15-16).

If individuals cannot achieve excellence without specialization, an education system that does not accommodate and indeed encourage specialization becomes a barrier to real excellence. People have diverse interests, diverse talents and diverse learning styles. The labor market is similarly diverse in the skills and talents that are sought. A "one size fits all" upper secondary education is bound to fail the majority of students. Our comprehensive secondary schools have historically accommodated this diversity by offering a great variety of courses (including occupation specific courses) and allowing students to select which courses to take. Higher education also offers students many options--different colleges, different majors and a host of electives. Most undergraduates and nearly all graduate students are engaged in occupation specific education. Other nations also recognize the diversity of students by allowing them to choose a specialization in the final years of high school and in university.

Employers agree that certain qualities--dependability, honesty, achievement motivation, literacy and numeracy--are important to success in all jobs. However, for many other competencies--sociability, leadership, foreign language skills, writing, algebra and spreadsheet computer programs--, the trait is important in some jobs but not in others. Occupational skills and experience are an important factor in hiring for most jobs. The better the job, the greater the weight given to occupation specific skills. This implies that the optimal preparation for one cluster of occupations is often quite different from the optimal preparation for another cluster. To compete for the better jobs, high school graduates need appropriate occupation specific skills as well as the five generic skills listed above.

The quote from Edgar Friedenberg illustrates a third reason for allowing students to pursue an occupational specialty in high school. What we believe we are good at tends to define the positive image we carry around about ourselves. Everyone needs to feel that they are excellent or at least above average at doing something important. The hands-on activities that characterize vocational classrooms offer students, who are good at making things but poor at academics, an opportunity to select a niche which interests them and to work constructively building competence in that vocation. The teachers and students who have chosen the niche reinforce each others belief in the value and importance of the vocation. Pride and self confidence is one result. Lower drop out rates is another.

The Doubts about Vocational Education

If vocational education has all of the positive qualities listed above, why is it shrinking in upper secondary schools throughout Europe and North America. Between 1982 and 1992 the number of vocational courses taken by the typical high school graduate fell by 11 percent. In addition, the percentage of high school graduates who "concentrated" [ie. earned at least 3 credits] in one labor market preparation area fell by 28 percent (Boesel et al, 1994b). Some have blamed the decline on legislated increases in the number of math and science courses required to graduate. But this does not explain parallel declines in occupation specific programs in European upper secondary schools. In my view increased graduation requirements was not the primary cause. Rather the primary cause was the doubling of the rate of return to college and the resulting rise in college attendance rates. The proportion of high school graduates who entered 2 or 4 year colleges the September following graduation rose by 20 percent between 1981-82 and 1991-92 (NCES 1994). Occupation specific course taking is normally concentrated in the last few years of a student's time in school. As college attendance and completion becomes more common, postponing specialization and occupation specific course taking until college should also become more common. And indeed it has. While vocational course taking in high school has declined, it has risen dramatically at the post secondary level. Despite a 13 percent decline in the size of the 18 to 24 age cohort, the number of occupational certificates and occupationally oriented AA and BA degrees has risen more than 20 percent. When thee the declines at the secondary level are subtracted from the increases at the post secondary

level, young people are clearly now receiving considerably more school-based occupation specific education than they did ten or twenty years ago. Enrollment in occupationally specific programs at postsecondary institutions has also grown rapidly Europe and this has been the primary cause of a shift from vocational to more academic lines of study in upper secondary school.

The doubts about occupation specific education are not to be found at the grass roots, but in elite opinion. The National Commission on Excellence in Education argued that educational reform was an economic necessity. "Learning is the indispensable investment required for success in the "information age" we are entering (1983, p. 7)," it proclaimed. Despite this, the Nation at Risk report was pretty much silent about how vocational education should be upgraded. Some of the reports calling for better schools expressed doubt about the economic benefits of the vocational education provided by secondary schools (Committee on Economic Development 1986).

Educational reform marches under a banner of economic renewal, but the school subjects that are most directly related to worker productivity--business education, vocational education, economics, computers--have, until recently, received little attention from most reformers. The five "core" subjects proposed for periodic assessment in the U.S. are English, mathematics, science, history/civics and geography. Yet, if competitiveness is the objective, it is not clear why geography, a subject that is not taught in most American universities, has higher priority than subjects like computers, economics, business management and applied technology?

Are the doubts that some opinion leaders have about vocational education justified? Are workers who develop the technical skills taught in trade and technical programs more productive when they get a job in the field? Are the skills taught in these programs still valued by the labor market? Has the payoff to high school vocational training declined? Or has it increased along with the payoff to other skills? What has the research analyzing large longitudinal data sets taught us about the effects to occupation specific education and training?

Should government subsidize schools which offer occupation specific education and training? Some have argued that government should force employers to do more training by scaling back government subsidies of school-based occupationally specific education and

training. The Economist (March 12 1994), for example, recently claimed that:

> Economists have long argued that the returns on general education are higher than those on specific training, because education is transferable whereas many skills tend to be job-specific. Today this case is becoming more compelling still as jobs become less secure, the service sector expands and the life-cycle of vocational skills diminishes and the market puts an even greater premium on the ability to deal with people and process information.

Instead, students should be taught generic academic skills such as reading, writing and mathematics that are useful in all or almost all work places. **These policy recommendations are, however, based on two premises--**

* **academic skills are good substitutes for occupation specific skills and**
* **increases in job turnover and skill obsolescence rates have caused a decline in the return to occupation specific training by schools--**

which, upon careful examination, turn out to be false. The first two parts of the report look at the evidence on these two issues.

Part 3 of the report examines the impact of school based occupational training on the learning of occupation specific skills and generic academic skills. Part 4 examines the impact of various types of school-based and employer-based occupational training on:

a) job performance in particular jobs,

b) the spread of new skills and technologies to organizations,

c) access to better jobs and to opportunities for further training and

d) steady employment.

Part 5 of the report examines a number of important policy issues that flow out of the two over-arching themes of the report: the critical role of occupational skills in determining productivity and labor market success and the need for closer collaboration between educational institutions and employers in developing these skills. It will not, however, be a comprehensive review of the many important policy issues facing vocational education today. Because I limit the discussion to issues and topics that have been addressed by well designed large scale research studies, a number of important policy issues must be neglected.

Every calling is great when greatly pursued.
--Oliver Wendell Holmes Jr., speech, Suffolk Bar Assoc. Feb. 5, 1885.

Tis not knowing much, but what is useful, that makes a wise man.
--Thomas Fuller, M.D. Gnomologia, 5097 (1732)

Part I.
EVIDENCE THAT OCCUPATIONAL SKILLS ARE ESSENTIAL

Let us begin with the question: **Are occupation specific skills really essential?** Or can generic cognitive skills like literacy and numeracy substitute for occupational skills. What about personality traits like dependability, honesty and achievement orientation. Clearly they are very important determinants of productivity and success in a job, sometimes more important that occupational skills. Can, however, these traits substitute for occupational skills? Or are they multiplicative in their contribution to productivity--ie. both are required for job success? Answering these question requires a careful examination of why schooling, achievement, job performance and job quality are positively associated. Types of schooling, types of achievement, types of jobs and different aspect of job performance must be distinguished.

To answer these questions the report examines five different kinds of evidence on the role of occupation specific skills in worker productivity .

1. The impact of occupation specific skills on hiring decisions
2. The impact of occupation specific skills on productivity on the job and relative wage rates.
3. The impact of generic technical competency on job performance in the civilian sector.
4. The impact of generic technical competency on training success and job performance of young military recruits.
5. The impact of generic technical competency on wage rates, earnings and unemployment.

1. THE IMPACT OF OCCUPATIONAL, ACADEMIC AND NON-COGNITIVE SKILLS ON HIRING DECISIONS

When employers are asked which skills they look for when hiring, they almost always cite work habits and occupational skills ahead of reading and mathematics skills. The applicants knowledge of history, geography and literature is seldom evaluated. Small employers do most of the hiring of young high school graduates, so it is important to understand what skills they are seeking when they select entry level employees. When members of the National Federation of Independent Business were asked "Which abilities influence hiring selections the most?", they cited occupational skills more frequently than any other ability.[1] **Forty percent ranked 'occupational skills (already has them)' number 1 and another 14 percent ranked them number 2** (see table 1). By contrast, only 6 percent ranked 'reading, writing, math and reasoning ability' number 1 and another 13 percent

Table 1
Abilities Sought When Hiring

	Percent Ranked			Mean Rank by Skill	
	#1	#2	#5,#6	High	Low
Occupational/job skills (already has them)	40	14	20	2.36	3.01
Ability to learn new occupational and job skills	15	26	13	2.96	2.84
Work habits and attitude (trying hard, enthusiasm, punctuality)	29	36	3	2.30	2.20
People skills (teamwork, appearance, getting along with others)	9	15	33	3.79	3.49
Leadership abil.(organize, teach & motivate others/solve problems)	1	2	54	5.16	5.33
Reading, writing, math and reasoning ability	6	13	39	5.65	3.83

ranked them number 2. Leadership and people skills were also seldom ranked at the top. The trait that most directly rivaled occupational skills was work habits. 'Work habits' were ranked most important 29 percent of the time and ranked number two 36 percent of the time. Only 3 percent of the employers ranked them #5 or #6. Clearly, good work habits are an important hiring criterion for just about every job.

There is more disagreement about the importance of already developed occupational skills. For 20 percent of the jobs, previous occupational skills ranked #5 or #6. This tended to be the jobs requiring less skill--service and clerical workers, operatives and sales clerks. In these lower wage jobs, work habits were the number one consideration, 'ability

to learn new occupational and job skills' was number 2 and already developed occupational skills was number 3. The ranking of 'reading, writing, math and reasoning' was last in the more highly skilled jobs and second from last in the less skilled jobs.[2]

2. THE IMPACT OF OCCUPATIONAL, ACADEMIC AND NON-COGNITIVE SKILLS ON JOB PERFORMANCE

2.1 Success on the Job

Once hired, which abilities predict success on the job? The NFIB survey also provides insight into this question. The owners supplied information on the background and on-the-job success of two employees (A and B) who had recently occupied the same job.[3] After the two employees had been at the firm for a year or more, the employers were asked "Which of the two employees (A or B) proved better on each of the following: 'occupational and job skills', 'ability to learn new occupational and job skills', 'work habits and attitudes', 'people skills (teamwork, appearance, getting along)', 'leadership ability (organize, teach and motivate others)' and as a group 'reading, writing, math and reasoning ability.'" They were asked to evaluate whether A was "much better", "better" or "no different" than B or whether B was "better" or "much better" than A. Since the firms were so small, the owners had contact with each worker, so judgements were probably quite well informed. In most cases owners perceived important differences in ability between their employees. In 78 percent of the cases the occupational skills of one of the two workers were judged to be "better" or "much better" than the other. For learning ability and work habits one worker was judged "better" or "much better" 69-70 percent of the time. Reading, writing, math and reasoning skills were judged different 58 percent of the time. Generally those who were strong along one dimension of ability were strong along other dimensions as well.

Which trait contributes most to overall job performance was determined by regressing global ratings of initial relative productivity of worker A and B on their ranking on each of the six different worker abilities while controlling gender, ethnicity and marital status. The results are given below:

(3) Productivity Differential in first two weeks on job = .023**(Basic Skills) + .093***(Occ Skills at hire) - .014(Learning Ability) + .000(Work Habits) + .011(People Skills) + .048***(Leadership)

(.011) (.010) (.012) (.011) (.012) (.013)

R^2 = .288
Obs = 977

Similar regressions were estimated predicting the differentials between worker A and B in the starting wage rate, current (or most recent) wage rate and productivity. Current age and productivity reports for the date of the interview which was an average of about one year after hiring. For separated employees the productivity report is for "two weeks before leaving the firm" and the wage report is for "at the time of separation." The results for all three labor market outcomes are presented in Figure 1. The bars in figure 1 represent the percentage differential in wage rates or productivity that results from one worker being 'much better' than another along one of the six ability dimensions while holding other abilities, tenure, ethnicity, gender, and marital status constant.

Ex-post assessments of relative occupational skill, learning ability, work habits and people skills all had significant positive relationships with relative global productivity ratings at approximately one year of tenure (the black bar in figure 1). Employer assessments of a worker's academic skills and leadership ability, by contrast, had no relationship with current overall job performance ratings. Holding demographics and employer evaluations of other traits constant, workers thought to have 'much better' occupational skills were judged to be 10.7 percent more productive after about a year on the job.

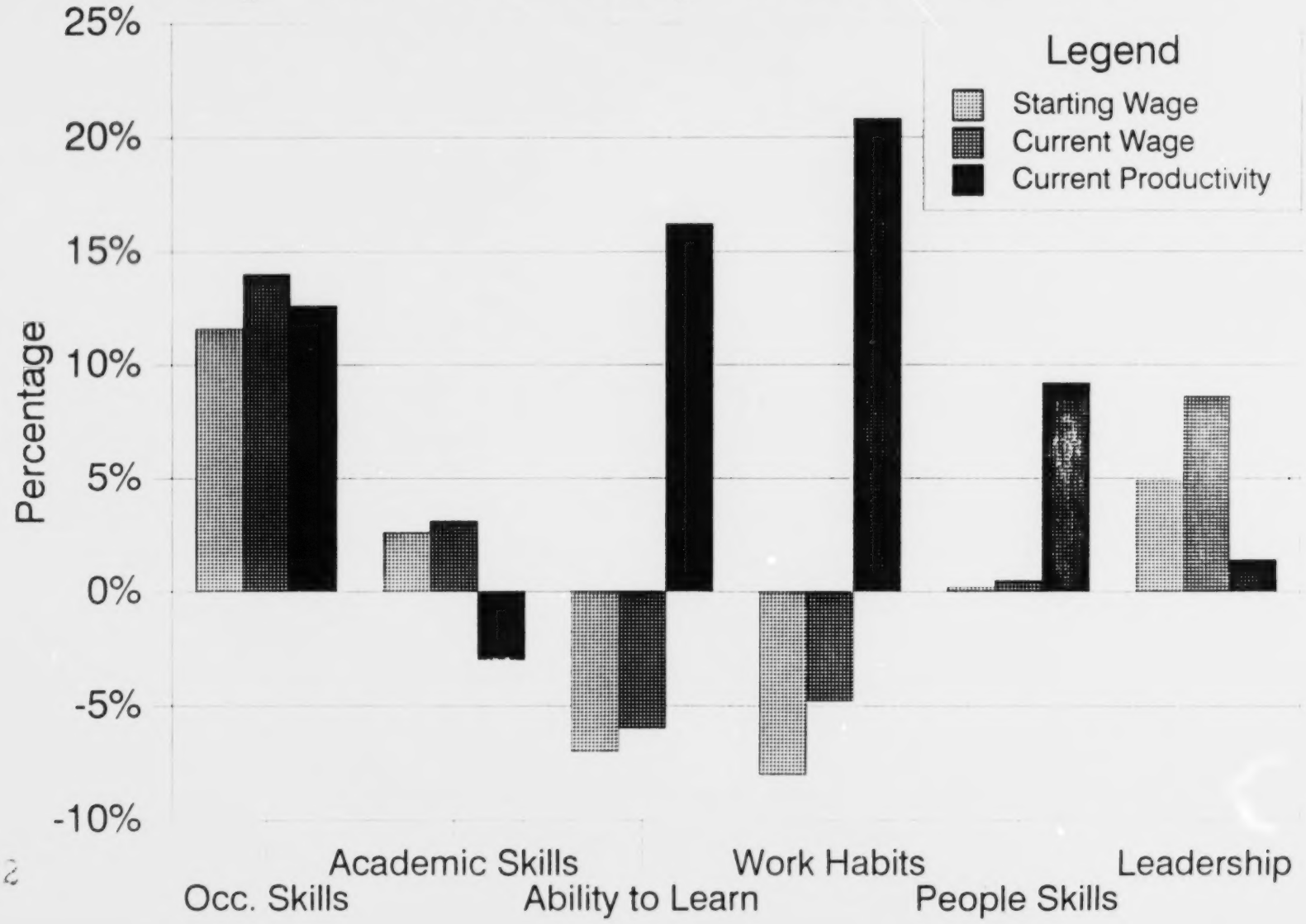
The impacts of occupational skills on relative wage rates are even more striking. **Occupational skills were the only ability that had large positive effects on the worker's wage rate.** Workers thought to be 'much better' in occupational skills started with a 12 percent better wage and were making 14 percent extra after a year or so on the job.

Academic skills had no significant effects on wage rates. People skills also had no effects on wage rates. Leadership had modest positive effects on wage rates and initial productivity but not on productivity a year later. The two abilities with the largest impacts on productivity a year later--ex-post assessments of work habits and the ability to learn new occupational and job skills--had significant **negative** relationships with wage rates.[4]

To summarize, **in almost all jobs productivity derives directly from social abilities (such as good work habits and people skills) and cognitive skills that are specific to the job, the occupation and the occupational cluster: not from reading, writing and mathematics skills.**

Figure 1

Wage and Productivity Effects of Abilities



2.2 Effects of Relevant Work Experience on Job Performance

Another way of assessing the importance of occupational skills is to examine what happens to worker productivity as they gain experience in a job. To do this we will hold the job constant and then compare the productivity of incumbents who have different amounts of tenure and prior relevant work experience. Analyses of the U.S. Employment Service's GATB Revalidation data on 31,399 workers in 159 different occupations at 3052 different firms indicates that both have substantial effects on job performance. This analysis is summarized in Table 2.

Relative to someone with no relevant work experience, a worker with 10 years of relevant prior work experience is predicted to be 28 percent more productive during the first couple of years in technical, craft and service jobs and 12 to 15 percent more productive in clerical and operative jobs. Marginal effects diminish as experience increases, but they do not reach zero until 37 years for operatives, 55+ years for craft workers and high skill clerical workers and 19-31 years for other occupations.

Productivity rises even more rapidly as tenure at the job increases. After ten years on the job, productivity had risen 84 percent in technical jobs, 68 percent in high skill clerical jobs, 62 percent in craft jobs, 45-47 percent in operative and service jobs and 32 percent in low skill service jobs.[5] The effect of tenure on job performance stops rising and starts to decline at somewhere between 16 and 24 years of tenure. Except for technicians, age (interpreted as general experience) has large effects on job performance as well. Holding tenure and occupational experience constant, being ten years older (28 rather than 18) raised productivity 8 percent in low skill clerical jobs, 17-18 percent in operative and service jobs, 23 percent in high skill clerical jobs and 33 percent in craft jobs.

2.3 Correlations between Job Knowledge and Job Performance

A third way to assess the importance of occupational skills is to measure them directly and then examine how strong the correlation is between these direct measures and overall ratings of job performance. The measures of occupational competency typically used by studies of this issue are paper and pencil tests of job knowledge for the specific occupation. Meta-analyses of the hundreds of empirical validity studies have found that content valid paper and pencil job knowledge tests are good predictors of job performance. Dunnette's (1972) meta-analysis of 262 studies of occupational competency tests found that

Table 2

Within-Job Productivity Effects of Previous Work Experience

	Occupation					
	Technician	Craft	Operative	High Skill Clerical	Low Skill Clerical	Service
10 Yrs Exp in Occ (at another establishment)	29%	28%	12%	12%	15%	28%
10 Yrs Tenure in Occ (at current establishment)	55%	34%	23%	56%	17%	19%
Age 28 rather than 18 (Sch. & Occ. Exper. held constant)	-3%	33%	17%	23%	8%	18%
Compensation in 1985	$26,649	$29,655	$23,828	$23,065	$19,472	$15,496
Output Standard Dev	$13,668	$12,399	$ 5,062	$ 8,925	$ 4,934	$ 4,068

Table entries are estimates of effects of a particular form of experience while holding other forms of experience, schooling, test scores, gender and ethnicity constant. The productivity effects are expressed as a percentage of the mean level of compensation in that occupation. Estimates of productivity effects in 1985 dollars may be obtained by multiplying the percentage reported in rows 1 to 3 by the mean compensation in row 4. These estimates hold the employer and the job constant and thus capture only a portion of the benefits of on-the-job learning. Learning also helps the individual enter higher paying occupations and obtain jobs at better paying companies and these effects are best measured by regressions predicting wages in representative samples of the population.

Sources for Table 4: Derived from an analysis of the U.S. Employment Services Individual Data File developed for revalidating the General Aptitude Test Battery. Deviations from the mean performance rating for the job were regressed on deviations from the mean values (for the job) of schooling, test scores, gender, race, Hispanic and tenure, total occupational experience, and age and their squares. Details are available in Appendix C of Bishop (1994). The higher rates of turnover of unsuccessful employees cause selectivity bias which was corrected for by multiplying the coefficient in table C1 of Bishop 1994 by 1.76 (Goldberger 198). The result was then multiplied by estimates of the standard deviation of output across workers taken form Bishop 1991. True effects are probably larger because both independent and dependent variables are measured with error and this causes our estimates to be biased toward zero. No correction was made for measurement error bias.

their average correlation with supervisory ratings was .51. This correlation was higher than the correlation of any other predictor studied including cognitive ability tests (.45), psychomotor tests (.35), interviews (.16) and biographical inventories (.34). Vineberg and Joyner's (1982) meta-analysis of military studies found that grades in training school (which were based on paper and pencil tests of occupational competency) had a higher correlation (.27) with global performance ratings by immediate supervisors than any other predictor. The correlations for the other predictors were .21 for ASVAB ability composites, .14 for years of schooling, .20 for biographical inventory and .13 for interest. Hunter's (1983) meta-analysis found that content valid job knowledge tests had a correlation of .48 with supervisory ratings and an even higher correlation of .78 with work sample measures of job performance. Consequently, for training program graduates who are employed in the occupation for which their competency was assessed, scores on these competency exams are highly valid predictors of job performance and promotion probabilities. Tests assessing job knowledge are also considerably better predictors of job performance than measures of the personality constructs associated with good work habits (Leatta Hough 1988)

When paper and pencil tests of occupational knowledge appropriate for the job compete with reading and mathematics tests to predict supervisor ratings of job performance, the job knowledge tests carry all of the explanatory power, the reading and mathematics tests none. When judged performance on a sample of critical job tasks is the measure of job performance, the beta coefficient on the job knowledge test is 2 to 4 times larger than the beta coefficient on a basic skills composite (Hunter, 1983). The research indicates that **VERBAL AND MATH ABILITIES DO NOT DIRECTLY EFFECT THE PRODUCTIVITY OF MOST WORKERS. Their contribution is to help the individual learn the occupation and job specific skills that are directly productive. Since large improvements in job knowledge are easier to achieve than equivalent (in proportions of a standard deviation) improvements in verbal and mathematical skills, occupationally specific training is highly desirable, if the student is likely to put the knowledge to use by working in the occupation or a closely related one.**

Occupational knowledge is cumulative and hierarchical in much the same way that mathematics and science is cumulative and hierarchical. Everyone must start at the bottom of the ladder of occupational knowledge and work their way up. The spread of information

technology and of high performance work systems is forcing workers to learn new skills, but the new skills are generally additions to, not replacements for, old skills. While learning a new skill is easier when the worker has good basic skills, a foundation of job knowledge and occupational skills is more essential. At some point every individual must start building his/her foundation of occupational skills. At the start the foundation building process involves learning skills relevant in a broad cluster of occupations (eg. office and management, construction occupations or electronics). The foundation building should begin at least two years before the individual plans to leave school, probably in 10th or 11th grade for those not planning to attend college full-time immediately upon graduating.

The research just reviewed demonstrates that occupation specific skills yield large benefits when workers get jobs in that occupation. What happens when the individuals's skills and the job's requirements are not so closely aligned? In technology education and industrial arts, for example, students are learning generic 'technical' skills that are hoped to be useful in a large variety of technical, craft, precision production and operative jobs. Is there such a thing as generic technical competence? Do tests of generic technical and mechanical abilities predict job performance in a host of different technical and craft jobs? Do such tests taken while still in school predict subsequent success in the labor market of representative samples of young adults? It is to these issues we now turn. The impacts of generic 'technical' competency on productivity and wages are examined in section 3, 4 and 5 of the paper.

3. The Effect of Technical Competence on Supervisory Assessments of Job Performance in the Civilian Sector

Over the last 50 years, industrial psychologists have conducted hundreds of studies, involving many hundreds of thousands of workers, on the relationship between supervisory assessments of job performance and various predictors of performance. In 1973 Edwin Ghiselli published a compilation of the results of this research organized by type of test and occupation. Table 3A presents a summary of the raw validity coefficients (correlation

Table 3

Raw Validity Coefficients

	Mechanical Comprehension	Intelligence	Arithmetic	Spatial Relations	Perceptual Accuracy	Psychomotor Abilities
Foreman	23[c]	28[c]	20[d]	21[d]	27[d]	15[b]
Craftworkers	26[d]	25[f]	25[f]	23[f]	24[e]	19[f]
Industrial Workers	24[d]	20[f]	21[f]	21[f]	20[f]	22[f]
Vehicle Operators	22[d]	15[d]	25[e]	16[e]	17[b]	25[d]
Service Occupations	----	26[d]	28[d]	13[d]	10[d]	15[d]
Protective Occupations	23[b]	23[d]	18[c]	17[d]	21[e]	14[d]
Clerical	23[d]	30[f]	26[f]	16[e]	29[f]	16[f]

Source: Ghiselli (1973) compilation of published and unpublished validity studies for job performance. The raw validity coefficients have not been corrected for restriction of range or measurement error in the performance rating. The Perceptual Accuracy category include number comparison, name comparison, cancellation and perceptual speed tests. They assess the ability to perceive detail quickly. Psychomotor tests measure the ability to perceive spatial patterns and to manipulate objects quickly and accurately. This category of tests includes tracing, tapping, dotting, finger dexterity, hand dexterity and arm dexterity tests.

[a] Less than 100 cases.
[b] 100 to 499 cases.
[c] 500 to 999 cases.
[d] 1,000 to 4,999 cases.
[e] 5,000 to 9,999 cases.
[f] 10,000 or more cases

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coefficients uncorrected for measurement error and restriction of range) for six types of tests: mechanical comprehension tests, "intelligence" tests, arithmetic tests, spatial relations tests, perceptual accuracy tests and psychomotor ability tests. As pointed out earlier, mechanical comprehension tests assess material that is covered in physics courses and applied technology courses such as auto mechanics and carpentry.

For craft occupations and semi-skilled industrial jobs, the mechanical comprehension tests are more valid predictors of job performance than any other test category. For protective occupations, mechanical comprehension tests tie intelligence tests for top rank in the validity sweepstakes. As one might expect, performance in clerical jobs is better predicted by intelligence, arithmetic and perceptual accuracy tests than by mechanical comprehension tests.

Paper and pencil assessments of technical competence and other cognitive competencies are in turn better predictors of job performance than questionnaire-based personality assessments intended to measure dependability, people skills and leadership qualities. Leatta Hough's meta analysis of personality literature is presented in Table 4. When questionnaires are the basis of measuring a personality trait, she found that Job Proficiency (ratings of overall job performance and indices of advancement) correlated only .08 with dependability scales, .15 with achievement motivation scales, .11 with 'locus of control' scales, .10 with potency/surgency scales, .09 with adjustment scales and .06 with agreeableness scales (see column 1). The weak relationships between job performance and questionnaire-based personality scales appears to contradict the testimonials from employers and supervisors about the great importance they assign to work habits. However, available measures of most personality dispositions are not very reliable and are subject to faking. This tends to cause studies like those reviewed by Leatta Hough to underestimate the true relationship between personality and job performance. A second possibility is that while employers agree that work habits are important, they mean different things when they use the phrase. If this is the case, defining the construct in a particular way (dependability rather than agreeableness, for example) results in lower associations with overall job performance ratings because some of the employers in the sample do not think this

Table 4
Personality Constructs
Meta-Analysis of Criterion Related Validity Studies

	CRITERION CONSTRUCTS					
Personality Constructs	Job Proficiency	Commendable Behavior	Non-Delinquency	Turnover Absenteeism	Training Grades	School GPA Yrs of School
DEPENDABILITY: Conscientious, Discipline well-organized, accepts authority	**8** 46,624	**23** 87,560	**52** 29,343	**10** 40,914	**11** 4,625	**12** 18,661
ACHIEVEMENT MOTIVATION: Hard Worker Strives for Competence	**15** 3,149	**33** 4,144	**42** 5,918	**14** 418	**21** 1,160	**29** 12,003
LOCUS OF CONTROL--Belief that Behavior Determines my Success	**11** 9,245	**13** 7,666	--	**3** 281	**28** 225	**32** 50
POTENCY: Degree of Impact, Influence & Energy, Lacks Timidity	**10** 66,612	**9** 53,045	**29** 29,950	**-1** 8,332	**6** 7,401	**12** 63,057
ADJUSTMENT: Emotional Stability & Stress Tolerance, Calm in a Crisis	**9** 35,782	**16** 20,555	**41** 36,210	**1** 7,408	**12** 8,685	**20** 70,588
AGREEABLENESS: Pleasant, Tactful, helpful, builds group cohesion	**6** 22,060	**8** 24,259	--	**-2** 7,598	**8** 988	**1** 7,330
AFFILIATION: Sociability, Friendly, likes wkg in groups, not shy.	**0** 4,057	--	--	**-1** 770	--	**1** 2,953
INTELLECTANCE: Socially polished, cultured, imaginative, quick-witted	**1** 11,964	**24** 747	--	**-8** 6,894	**2** 8,744	**13** 3,628

Source: Leatta Hough 1988. Weighted mean correlations (multiplied by 100) are in large bold print. They were not corrected for unreliability or restriction of range. The total number of individuals in the studies from which the mean correlation was calculated is in small print under the correlation. Job Proficiency indicators are supervisory ratings of technical proficiency or overall performance and indicators of rates of advancement. Commendable Behavior includes ratings of effort or hard work, involuntary terminations, demotions, disciplinary actions and letters of recommendation or reprimand. Non-Delinquency includes theft, imprisonment and delinquent or criminal behavior. Turnover-Absenteeism is based on studies of voluntary turnover, tenure and attendance (not job satisfaction). Training Performance includes instructor ratings, course/exam grades and field tests. For all constructs the preferred outcome is coded in the positive direction.

particular trait is all that important. Either way, personality traits such as dependability, achievement motivation and people skills are difficult to predict prior to hiring. Consequently, hiring decisions tend to be based on very imperfect proxies for these traits derived from recommendations, work histories and interviews. Other easier to evaluate characteristics of the worker such as occupational skills and cognitive ability also have important effects on hiring decisions (Bishop 1993).

When other indicators of job performance such as ratings of effort or hard work, letters of recommendation, letters of reprimand, demotions, and involuntary terminations are the criterion, personality scales have stronger relationships. Studies predicting these outcomes--referred to generically as commendable behavior--obtained average correlations of .23 with

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dependability scales, .33 with achievement motivation scales, .13 with locus of control scales, .09 with potency scales, .16 with adjustment scales and .08 with agreeableness scales.

In summary, validity studies suggest that for technical, craft and operative jobs, paper and pencil measures of technical competence are better predictors of overall job proficiency than tests of basic academic skills and paper and pencil assessments of personality. Personality tests assessing dependability and achievement motivation, on the other hand, are better predictors of commendable behavior--ratings of work effort and not being fired-- than tests assessing technical and basic academic skills. The studies just reviewed are primarily from the civilian sector of the economy. These findings get further support when we examine military data.

4. The Effect of Technical Competence on Training Success and Job Performance in the Military

The best research on the impact of technical competence on the ability to learn new tasks of a technical character and performance on the job has been conducted in the U.S. military. All four services use the Armed Services Vocational Aptitude Battery (ASVAB), a three hour battery of tests, to select recruits and assign them to occupational specialties. The test battery is made up of 10 subtests: Mechanical Comprehension, Auto and Shop Knowledge, Electronics Knowledge, Clerical Checking (Coding Speed), Numerical Operations (a speeded test of simple arithmetic), Arithmetic Reasoning, Mathematics Knowledge (covering the high school math curriculum), General Science, Word Knowledge and Paragraph Comprehension. The first three of these subtests measure what I call **technical competence**. Examples of the questions from these three subtests are given in Exhibit 1. The universe of skills and knowledge sampled by these ASVAB subtests roughly corresponds to the vocational fields of trades and industry and technical. Some of the material is also covered in physics courses.

Even though the ASVAB was developed as an "aptitude" test, the current view of testing professionals is that:

> Achievement and aptitude tests are not fundamentally different.... Tests at one end of the aptitude-achievement continuum can be distinguished from tests at the other end primarily in terms of purpose. For example, a test for

> mechanical aptitude would be included in a battery of tests for selecting among applicants for pilot training since knowledge of mechanical principles has been found to be related to success in flying. A similar test would be given at the end of a course in mechanics as an achievement test intended to measure what was learned in the course (National Academy of Sciences Committee on Ability Testing, 1982, p.27)."

These subtests have some similarities with the occupational competency examinations developed to assess vocational students. However, the ASVAB technical subtests assess knowledge in a much broader domain and the individual items are, consequently, more generic and less detailed. Therefore, the ASVAB technical composite is interpreted as a measure of knowledge and trainability for a large family of jobs involving the operation, maintenance and repair of complicated machinery and other technically oriented jobs.

4.1 Studies of Training Success and Job Performance

The ability of the ASVAB test battery to predict job performance in a variety of Military Occupational Specialties (MOS) has been thoroughly researched and the battery has been periodically modified to incorporate the findings of this research (Booth-Kewley 1983, Maier and Truss 1983 & 1985, Wilbourn, Valentine & Ree 1984).

Most of the research has involved correlating scores on ASVAB tests taken prior to induction with a paper and pencil job knowledge test at the end of training generally about 4 months later. A reanalysis was conducted of data from two large scale studies of Marine recruits (Sims and Hiatt 1981 reprinted in Hunter, Crossen and Friedman 1985; Maier and Truss 1985).

Studies of success in training are not, however, studies of job performance. The determinants of job performance may be different. Knowledge of mathematics, science and English might well predict scores on a paper and pencil test assessing knowledge about truck repair, but not predict how well an individual can actually diagnose and repair a truck. It is, therefore, essential to study how well the ASVAB predicts actual job performance. Maier and Grafton's (1981) study of ASVAB 6/7's ability to predict the hands-on Skill Qualification Test (SQTs) provides such a data set. Maier and Grafton described the hands-on SQTs they used in their study as follows:

SQTs are designed to assess performance of critical job tasks. They are

> criterion referenced in the sense that test content is based explicitly on job requirements and the meaning of the test scores is established by expert judgment prior to administration of the test rather than on the basis of score distributions obtained from administration. The content of SQTs is a carefully selected sample from the domain of critical tasks in a specialty. Tasks are selected because they are especially critical, such as a particular weapon system, or because there is a known training deficiency....The list of tasks in the SQT and the measure themselves are carefully reviewed by job experts and tried out on samples of representative job incumbents prior to operational administration (pp.4-5).

Regressions were estimated predicting both final training grades and hands-on SQTs. The findings for non-clerical non-combat jobs are summarized in Figure 2. The findings for clerical jobs are summarized in Figure 3 (see Bishop 1989c, 1992b, 1993 and Appendix Tables A1 and A2 for full results). The darker bars report my estimate of the effect of a one population standard deviation (PopSD) improvement in each of the ASVAB subtest composites on the hands-on job performance (SQT), while holding all other test scores constant. The productivity effects have been translated into a metric of percent of mean compensation for similar civilian jobs. The key assumption that makes this calculation possible is that the standard deviation of true productivity across soldiers in that occupation is 30 percent of the mean compensation in comparable civilian occupations. Appendix A provides a justification of this assumption. No effort was made to correct for the biases caused by errors in measuring competence so these results provide lower bound estimates of the effects of the true competencies on true job performance. The white bars provide similar estimates from models predicting training success. In order to retain comparability of metric for the training success and job performance results, the standardized regression coefficients from the models predicting grades on job knowledge tests have also been multiplied by .30.

Technical competency had major effects on success in training for all of the non-clerical military occupations. It had even larger effects on job performance. A one PopSD increase in technical competency increased our productivity index by 11.9 percent of mean compensation or about $4280 per year in 1993 dollars. The present discounted value at age 18 of such a learning gain is about $78,000 (using a 5 percent real rate of discount).[6] These results imply that broad **technical literacy** has a very large payoff for workers who use and/or maintain equipment that is similar in complexity to that employed in the military.

Figure 2

Effects of Skills on Productivity in Non Clerical-N

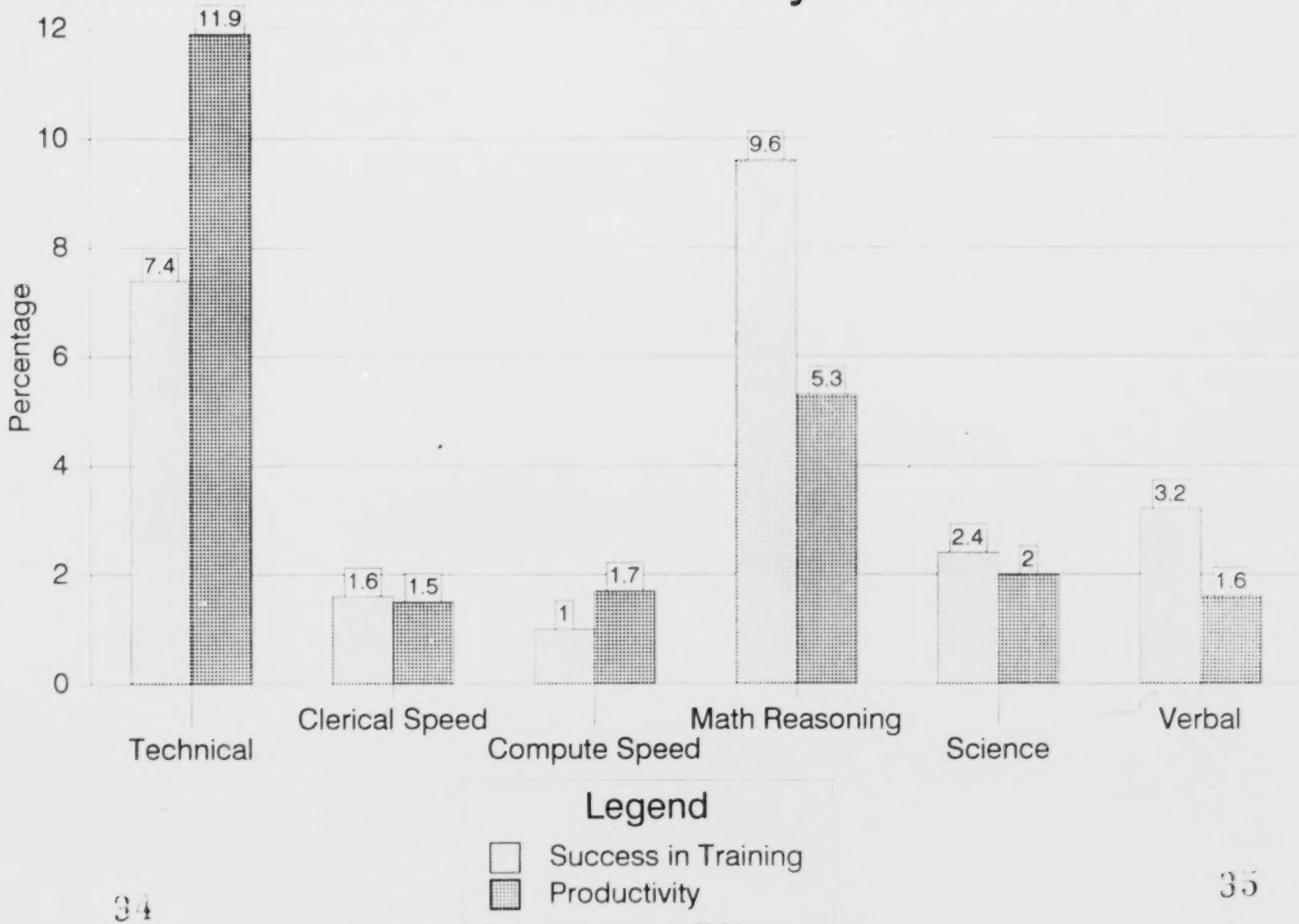
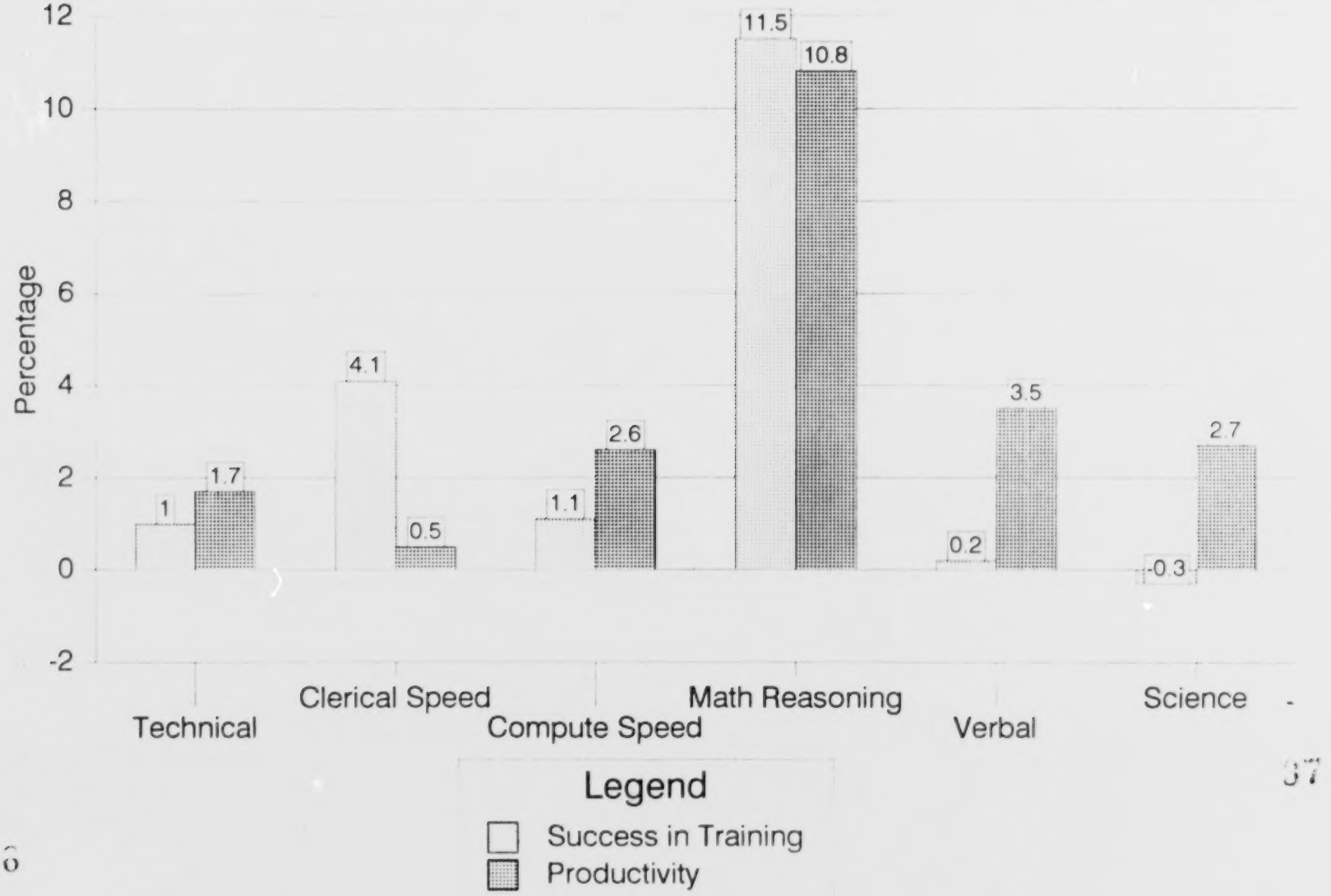


Figure 3

Effects of Skills on Productivity in Clerical Jobs



Mathematical reasoning ability also had large positive effects on both training success and job performance.[7] For non-clerical jobs, a one PopSD increase in both mathematics reasoning subtests increased the productivity index by 5.3 percent of average compensation or $1906 per year in 1993 dollars. For clerical jobs a one PopSD increase in mathematics reasoning ability raised productivity by 10.8 percent or $3277. per year. The present discounted value of one POPSD of math reasoning is $34,700. for non-clerical jobs and $59,640. for clerical jobs. The Math Knowledge subtest assessing algebra and geometry, not the arithmetic reasoning subtest, which had the largest effect on job performance. Other types of academic achievement--verbal ability, scientific knowledge and computational speed--had much smaller effects. While the effects of the mathematical reasoning composite on job performance in non-clerical jobs are substantial, their effects are substantially smaller than the effects of the technical composite.

Note how the technical subtests have larger effects on hands-on job performance than on job knowledge while the mathematics and verbal tests have smaller effects. This suggests that technical competence is a stronger determinant of actual job performance than of paper and pencil job knowledge test scores.

4.2 Predicting Supervisory Assessments

Most of the ASVAB validity studies have studied MOS specific measures of performance which reflect the soldier's ability to do the job not their willingness to do it on a regular basis or under adverse conditions. Do the results change when other dimensions of job performance are studied? The Joint-Service Job Performance Measurement/Enlistment Standards (JPM) Project has collected data which allows us to address this issue. Besides the MOS specific SQTs already examined, Project A offers three other performance constructs which have some applicability to civilian jobs: General Soldiering Proficiency, Effort and Leadership and Maintaining Personal Discipline. General Soldiering Proficiency assesses skills that all soldiers must have (eg. use of basic weapons, first aid, map reading, use of a gas mask) and is a combination of job knowledge tests and hands-on performance tests. This construct is a measure of the <u>can do</u> element of job performance.

The other two constructs attempt to measure the <u>will do</u> element of job performance.

John P. Campbell (1986) described the constructs and their measurement as follows:

> Peer Leadership, Effort, and Self Development: Reflects the degree to which the individual exerts effort over the full range of job tasks, perseveres under adverse or dangerous conditions, and demonstrates leadership and support of peers. That is, can the individual be counted on to carry out assigned tasks, even under adverse conditions, to exercise good judgement, and to be generally dependable and proficient? Five scales from the Army-wide BARS rating form (Technical Knowledge/Skill, Leadership, Effort, Self-development, and Maintaining Assigned Equipment), the expected combat performance rating, and the total number of commendations and awards received by the individual were summed for this factor.
>
> Maintaining Personal Discipline: Reflects the degree to which the individual adheres to Army regulations and traditions, exercises personal self-control, demonstrates responsibility in day-to-day behavior, and does not create disciplinary problems. Scores on this factor are composed of three Army-wide Bars scales (Following regulations, Self-Control, and Integrity) and two indices from the administrative records (number of disciplinary actions and promotion rate). (p. 150)

It had been planned to obtain information on commendations, awards, promotions, and disciplinary actions from administrative records. However, the cost of this approach was high so "everyone crossed their fingers and we collected eight archival performance indicators via a self report questionnaire....Field tests on a sample of 500 people showed considerable agreement between self-report and archival records"(Campbell, 1986, p 144).

These two constructs were related to each other (they correlate .59) but were clearly quite distinct from the two "can do" constructs. Correlations with General Soldiering Proficiency were only .27 for Effort and Leadership and .16 for Personal Discipline. The "can do" constructs were based on ratings made by the same person, so they share some common measurement error. Campbell, consequently, developed residualized "can do" performance constructs by subtracting a ratings method factor from the raw score. With the ratings methods effect removed, General Soldiering Proficiency (raw) had a correlation of .45 with Effort and Leadership (residual) and .19 with Personal Discipline (residual). In the view of the JPM research team, soldiers must have both qualities--the technical competence to do their job and the willingness to do it under stressful circumstances.

Table 5 presents results of regressions predicting General Soldiering Proficiency

Table 5

Determinants of Army-Wide Performance Constructs

Predictor Constructs	General Soldiering (raw score)		Effort & Leadership (residual)		Effort & Leadership (raw score)		Personal Discipline (raw score)	
	M1	M2	M1	M2	M1	M2	M1	M2
ASVAB Composites								
Technical	.26	.12	.21	.11	.21	.15	.06	.07
Speed	.03	--	.07	.04	.09	.06	.04	.03
Quantitative	.20	.09	.08	.04	.03	--	.07	.05
Verbal	.10	.09	.03	.03	-.07	-.06	-.03	--
Overall Spatial	--	.25	--	.13	--	--	--	--
Complex Percept Accuracy	--	.08	--	--	--	.04	--	--
Complex Perceptual Speed	--	--	--	--	--	.05	--	--
Temperament								
Dependability	--	.11	--	.06	--	.11	--	.30
Achievement/Surgency	--	-.04	--	.15	--	.20	--	.03
Physical Condition	--	--	--	.03	--	--	--	-.05
Interests								
Combat	--	.13	--	.11	--	.10	--	--
Food Service	--	-.04	--	-.08	--	-.06	--	-.04
Audiovisual Arts	--	--	--	-.02	--	-.04	--	-.03
Job Values								
Prefers Routine	--	-.03	--	-.04	--	-.03	--	--
Prefers Autonomy	--	--	--	--	--	--	--	-.05
Corrected Multiple **R**	.461	.540	.280	.392	.206	.366	.106	.317

Source: Beta coefficients from Table 10 and 12 of Campbell (1986). M1 includes only the four ASVAB composites that were measured prior to entry into the army. M2 is the result of a stepwise regression using 24 predictor constructs. Variables with very low contributions to explanatory power were dropped. The Multiple R has been corrected for shrinkage but not for restriction of range or unreliability of the criterion. Sample size was approximately 10,000. All 20 non-ASVAB constructs were measured concurrently with the measurement of performance. The overall spatial construct is a composite of 6 paper and pencil tests of spatial orientation, spatial visualization and induction-figural reasoning. The Complex Perceptual Accuracy is the percent correct on computerized tests of short term memory, target identification and perceptual speed and accuracy. The Complex Perceptual Speed factor is average reaction time on these same tests times -1. The Dependability factor combines a conscientiousness scale and a non-delinquency scale. The Achievement/Surgency factor is composed of scales measuring self-esteem, work orientation and energy level. The Combat Interest Factor is a composite of a combat, rugged individualism and firearms enthusiast scales. Variables which entered none of the regressions--skilled technical and structural/machines interest factors, an emotional stability scale, simple reaction accuracy and an index measuring preference for organizational and co-worker support--are not shown. The other variables not shown had very small and inconsistent betas (< .04): 4 perceptual speed tests and an interest in protective service occupations factor.

(raw), Effort and Leadership (both raw and residualized) and Personal Discipline (raw) (Campbell, 1986, Table 10 & 12). In this analysis the 10 ASVAB subtests were reduced to four composites: Technical, Speed (Numerical Operations and Clerical Checking), Quantitative (Arithmetic Reasoning and Mathematics Knowledge) and Verbal/Science. Model 1 regresses the performance construct on these four ASVAB composites.

For General Soldiering Proficiency, the results were quite similar to the results obtained predicting hands-on SQTs. The technical and quantitative composites had the largest effects, and the verbal/science composite had a substantial effect. Speed had almost no effect.

The pattern was different for the "will do" performance constructs. The technical composite had large positive effects on both measures of Effort and Leadership. The quantitative composite had a modest positive effect on Maintaining Personal Discipline and the residualized Effort and Leadership. Speed had a modest positive effect on Effort and Leadership. The verbal/science composite had no effect on the residualized Effort and Leadership and a small negative effect on raw score measures of both constructs.

The inclusion in Model 2 of controls for temperament, occupational interests and cognitive constructs not found in the ASVAB such as spatial relations and perceptual speed modifies these results only a little. The control variables were all measured concurrently and consisted of 6 interest variables (combat, food service, audio/visual arts, protective service, skilled technical and structural/machines), six computer administered perceptual speed and accuracy tests, four measures of temperament (dependability, physical condition, emotional stability and achievement/surgency), a composite of paper and pencil spatial relations tests and three indexes assessing the individual's preference of autonomy, routine and support from the organization and co-workers on the job.[8] These control variables are described in Campbell (1986).

For the "can do" performance constructs, adding the new concurrently measured cognitive and non-cognitive predictors to the model somewhat increases the explanatory power of the model above that obtainable with ASVAB test scores alone. The multiple R rises from .461 to .540 for General Soldiering Proficiency (McHenry et al 1986). The coefficients on the ASVAB composites shrink but the pattern across composites is similar. The verbal/science and quantitative composites have effects that are each about three-

quarters the effect of the technical composite. Spatial relations composite is the most important variable.

The pattern is quite different for the "will do" performance constructs. The new non-cognitive predictors contributed significantly to the explanation of the "will do" performance constructs. Adding all the new concurrently measured predictors to a model based solely on ASVAB test scores raised the multiple R (uncorrected for restriction of range and unreliability of the criterion) for Effort and Leadership (raw) from .206 to .366 and raised the multiple R for Maintains Personal Discipline from .106 to .317. The most important determinants of 'Effort and Leadership' were the personality scales for Achievement/Surgency and Dependability. For 'Maintains Personal Discipline,' the Dependability scale had by far the strongest association. Of the four indicators of cognitive achievement, Technical ability had the largest effects on these two 'will do' performance constructs. Speed had a small positive effect on Effort and Leadership. The verbal/science composite had negative effects on both of these constructs. Effort and Leadership was positively associated with the 'Interest in Combat' interest scale. The 'Prefers Routine' scale and Interest in food service occupations and audio/visual arts scales had small negative effects on the 'will do' performance constructs.

Eighty percent of the jobs held by enlisted personnel in the military have civilian counterparts so the research on the validity of the ASVAB in military settings just presented should generalize quite well to major segments of the civilian economy (US Department of Defense, 1984).

These results are consistent with the analysis of job performance in civilian sector reported in Section 3 of the paper. Measures of generic technical competence are highly correlated with job performance in technical and blue collar jobs in both military and civilian settings. Does this result in young men with technical competencies getting better jobs and spending less time unemployed? It is to this question we now turn.

5. The Effect of Technical Competence on the Wages, Earnings and Unemployment of Young Men

How do technical competencies developed in one's youth influence subsequent labor market outcomes of young men? This question can be answered by estimating models predicting wage rates, earnings and unemployment of young men as a function of competence in the academic fields of mathematics, science and language arts and in the trade/technical arena while controlling for years of schooling, school attendance, ethnicity, age, work experience, marital status and characteristics of the local labor market.

Three measures of labor market success were studied: the log of the hourly wage rate in the current or most recent job taken from the 1981, 1982, 1983, 1986, 1989 and 1991 interviews and annual earnings and unemployment for calendar years 1981, 1982, 1983, 1986, 1988 and 1990.[9] The sample was limited to those who were not in the military in 1979. At the time of the 1991 interview the NLS Youth ranged from 26 to 33 years of age.

The labor market effects of skills developed early in life were examined by regressing earnings and the logarithm of the wage rate on ASVAB subtest scores, years of schooling, current attendance in school, Black, Hispanic, age, age squared, region and residence outside an SMSA and rural residence (Bishop 1992b). Holding academic competencies in 1980 constant, one additional year of schooling raised earnings of young men by an average of $986 in 1986 (6.8 percent) and by $2072 in 1990 (9.3 percent).

Two dimensions of mathematical achievement were measured: the speed of doing simple mathematical computations is measured by a three minute 50 problem arithmetic computation subtest which will be referred to as computational speed. Mathematical reasoning ability was measured by a composite of the mathematics knowledge and arithmetic reasoning subtests. As before technical ability was measured by a composite of the mechanical comprehension, electronics information and auto-shop information subtests.

The effects of a one population standard deviation [approximately 5 Grade Level Equivalents (GLE)] increase in various kinds of achievement are presented in Figures 4 and 5. Results will also occasionally be reported relative to a metric of grade level equivalents (GLE) by assuming that one population standard deviation on subtests of the ASVAB and the verbal and mathematics subtests of the GATB are equal to 5 GLEs. This is done for the convenience of the reader and does not reflect the actual association between years of

Figure 4

Wage Rate Effects of Skills for Males (1 Pop SD)

Controls for Age

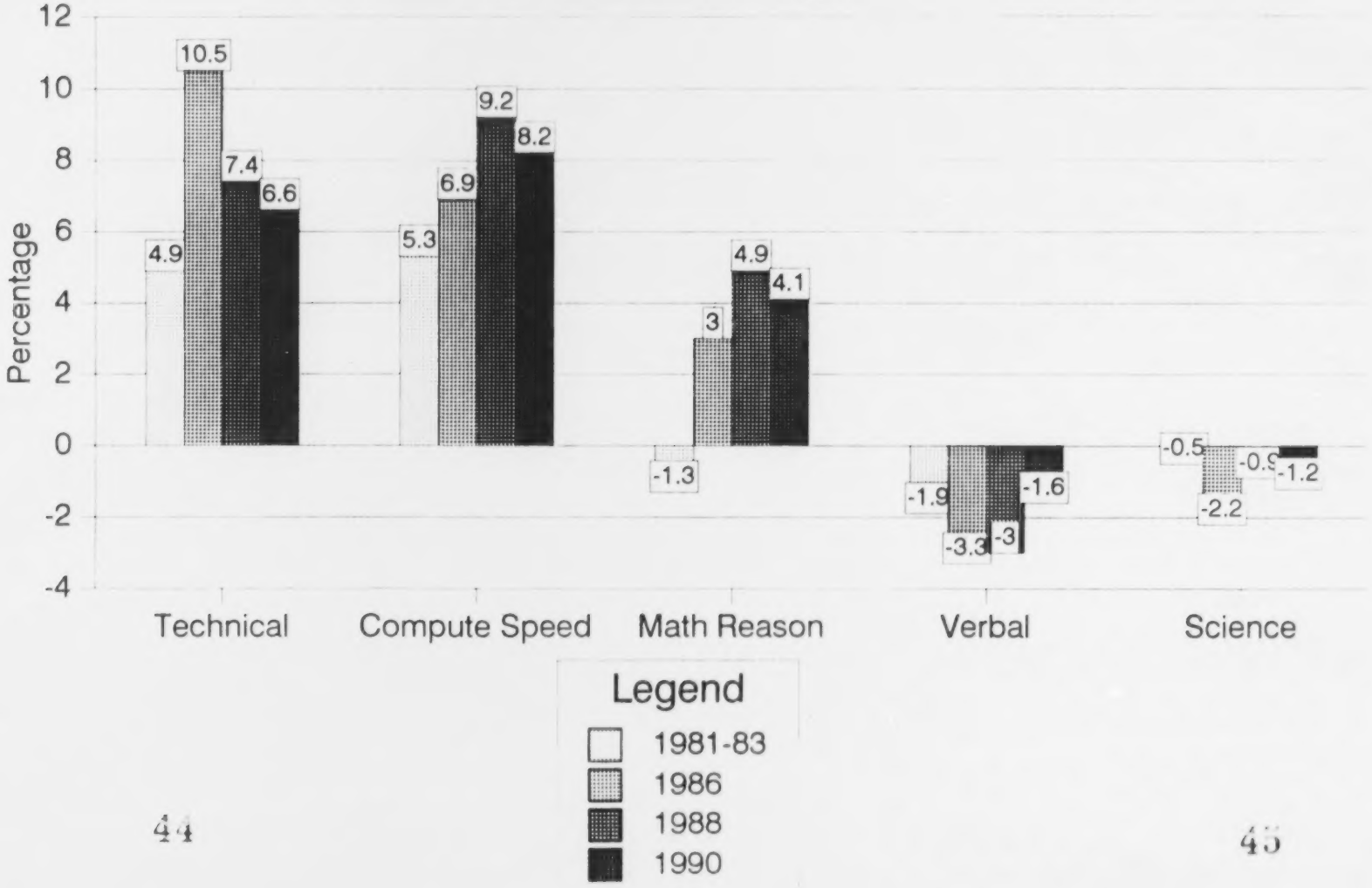
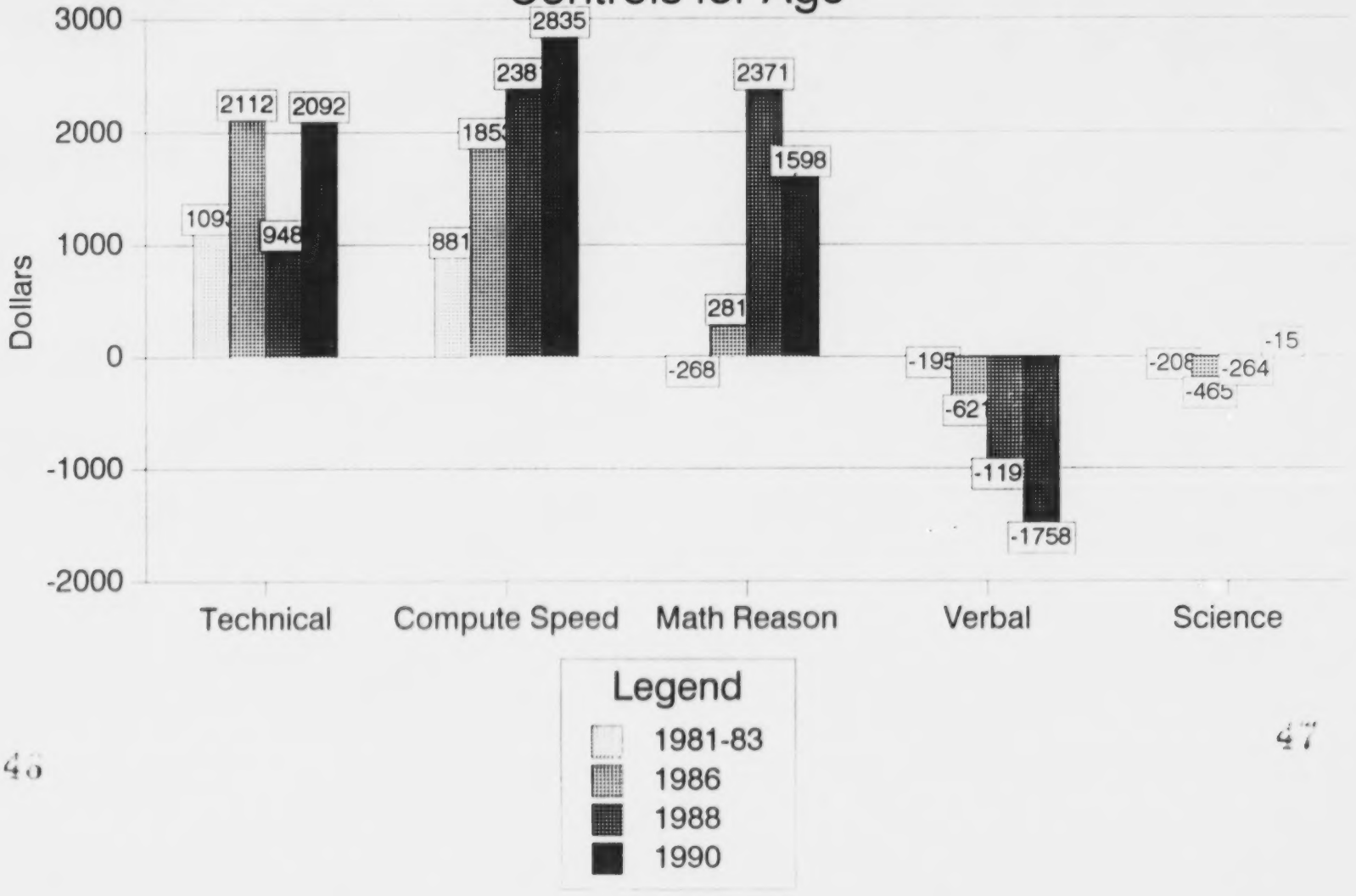


Figure 5

Earnings Effects of Skills for Males

Controls for Age



schooling and particular subtests in this data set. Sorting and learning both contribute to observed relationships between schooling and test scores, so a GLE will generally be larger than the true value added of one year of schooling.

For young men, the ASVAB technical subtests measuring electronics knowledge and mechanical, auto and shop information had large and significant positive effects on wage rates and earnings at all ages. A one GLE increase in technical competence raised wage rates by 2.1 percent in 1986 and 1.3 percent in 1990. These subtests had no effect on the labor market success of young women.

High level academic competencies, by contrast, did not have significant positive effects on wage rates and earnings of young men. Controlling on years of schooling and school attendance and other test composites, the verbal and science composites had negative effects on wage rates and earnings even for men around 30 years old. The math reasoning composite had a small negative effect during the early 1980s when the sample was under age 25 (Bishop 1991) and a modest positive effect in the late 1980s once the respondents were over age 25. Low as these returns may appear at the end of the 1980s, they were even lower in the 1970s (Murnane, Willett and Levy 1992).

Speed in arithmetic computation had substantial positive effects (for wage rates approximately +1.6 percent per GLE) on labor market success of young men of all ages. This competency, however, is a lower order skill that is not (and should not be) a focus of high school mathematics instruction (National Council of Teachers of Mathematics 1980).

These results are not unique to this data. Willis and Rosen's (1979) analysis of NBER-Thorndike data, Kang and Bishop's (1986) analysis of High School and Beyond seniors and Bishop, Blakemore and Low's (1985) analysis of both Class of 1972 and High School and Beyond data came to similar conclusions.[10]

The weak impact of academic achievement in high school on earnings as a young adult is also not unique to academic competencies. The youth labor market also fails to reward graduates who develop good work habits in school. High school students who were seldom absent, who had good study habits, who stayed out of trouble in school, demonstrated good citizenship and who held leadership positions in extra-curricular activities do not get better jobs in the years immediately following high school than those who do not (Hotchkiss 1984, Rosenbaum 1990).

Summary: In sum, analysis of labor market data for young males finds strong evidence that technical competence is strongly related to higher wages, greater earnings and lower unemployment. The analyses presented in Sections 1 through 5 provide strong evidence that both generic technical competence and occupation specific competencies have large effects on worker productivity and other indicators of labor market success.

What about generic cognitive abilities like reading, writing and mathematics? What, for example, would happen if reading, writing, mathematics and generic problem solving abilities of workers magically increased, but other worker traits (eg. occupational skills and motivation) remained fixed? I/O psychologists have answered this question. If improved basic skills do **not** lead to better occupation and job specific skills, productivity would not appreciably improve. Basic skills seldom directly impact productivity: they help by making it easier for the worker to learn the occupation and job specific skills that are directly productive. Basic academic skills can not be substituted for occupational skills. When jobs are technical in nature, research conducted in the military indicates that previously acquired technical competence has a bigger effect on learning new job skills and job performance than basic academic skills.

What about personality dispositions such as dependability, achievement motivation, sociability and people skills? Some of these traits are important in just about all jobs. Others such as sociability and people skills are important in some jobs and not so important in other jobs. In some low skill jobs good work habits are about all that is required. In higher level jobs, however, workers need both the "can do" (occupational and job) skills and the "will do" skills (dependability, honesty and achievement motivation). I hypothesize, but cannot prove with data available now, that these two categories of skill are multiplicative in complex jobs. A highly skilled worker who is poorly motivated and dishonest is useless. Similarly a sincere, well motivated worker who hasn't a clue about how to repair a car is also useless in auto repair job. The worker who combines a full measure of both qualities is a joy and is soon promoted to supervisor.

While basic skills and good work habits cannot substitute for occupational skills, it still might be socially optimal for firms to select new hires on the basis of literacy, numeracy and good work habits, and then teach the required occupational skills. Should firms be asked to do most of the nation's occupational training? It is to this question we now turn.

The direction in which education starts a man, will determine his future life.
--Plato, The Republic, tr. Benjamin Jowett, (4th c B.C.)

A man must always study, but he must not always go to school.
--Montaigne, "All things have their season" Essays, (1580-88)

However much thou art read in theory, if thou hast no practice, thou art ignorant.
--Sa'Di, Gulistan, 8.3, tr. James Ross, (1258)

PART II
OCCUPATION SPECIFIC TRAINING: SCHOOLS vs EMPLOYERS

6. Are Occupation Specific Skills Best Taught by Schools or by Employers?

In the 19th century occupational training was provided by parents, apprenticeships and employers. Over the course of the 20th century many of these training functions have been transferred to schools. Indeed, the switch of training functions to schools is a natural part of the life cycle of a technology and its associated skills. As a technology matures and its use grows, the skills associated with a technology become standardized (ie. general rather than firm specific), the demand for formal training grows and schools enter the market as training providers (Flynn 1988). Where are occupational skills best developed?

6.1 Advantages of School Based Occupational Training

Once skills become standardized, schools have natural advantages as competitors in this market: (a) they offer students flexibility in scheduling and the choice of courses, (b) hourly costs of training are lower because teaching staff are specialized and economies result from spreading the cost of developing courses over many students, (c) school certification of skills makes them more portable, and (d) schools and students have access to public subsidies not available when training takes place at a firm. Another advantage of school based occupational training is that they allow individuals to select the occupation for which they will prepare. When firms provide occupational training, competition to enter an occupation occurs before training rather than after.

When trainers with the necessary expertise are scarce, schools are a way to get the most out of a limited supply of expert trainers. Frequent teaching of a course should enable improvements to be made. Many enterprises are too small to mount training by themselves and so must rely on training programs organized by schools and trade associations. For some topics, even very large enterprises lack a sufficient flow of interested trainees to warrant hiring an expert to provide specialized training.

School-based occupational training also facilitates the spread of the latest knowledge and techniques to millions of work places. Owners and managers cannot be expected to be well informed about the technological developments and organizational innovations that may make their company more effective. Consequently, they seek to recruit and develop staff who will help perform the scanning, assessing and innovating function. Hiring graduates of schools with reputations for being at the cutting edge and sending key staff for seminars is a way many companies try to stay abreast of new developments. This is one of the ways ideas and innovations first developed at one firm (or by a university researcher or a government lab) get transmitted to other firms in the industry.

When schools become major training providers, barriers to entry into the occupation and the industry fall, the supply of skilled workers grows, the costs of employing people with the skill fall, and expanded use of the technology is facilitated.

On the other hand, school based training cannot replace some kinds of employer training and may be less effective than employer provided skill training of the same duration. That, at least, is what Peter Elias, Erik Hernaes and Meridith Baker (1994) argue:

> Economic arguments would predict that a school based system for the provision of vocational skills, delinked from the demand for labor, would show a lower rate of return per unit of time spent acquiring skills than an employer based system, because the latter system could incorporate firm specific training and may obviate the difficulties of matching the supply of skilled labor to demand in the absence of market mechanisms (p. 296).

What are the advantages to locating skill training at firms rather than schools? Let us examine them.

6.2 Advantages of Locating Occupational Training at the Work Site

Often, training in a skill can only be organized by the employer. This is clearly the

case when skills are specific to the firm or partially specific to the firm, but is also sometimes the case for completely general skills as well. General skills are often easier to learn when they are integrated into a training program that is specific to the context of a particular firm. This has been shown to be true for adults being taught basic literacy skills (Mikulecky 1989). The need for particular general skills is often generated by the introduction of new technology and new equipment or a reorganization of the business. Since firms quite reasonably desire to have all employees use the same word processing and financial analysis programs, the selection of the applications programs must be centralized. IBM first developed the FORTRAN computer language and then taught it to its employees and customers. Colleges and universities eventually offered courses in FORTRAN, but it took many years for schools to take over the bulk of the teaching of this very general skill.

Even when the same skills are taught, employer provided training is generally more effective per hour of trainee time than school based training? Seven reasons appear to account for this.

First, training obtained at a school is less likely to be used on one's job than training received from an employer. For graduates of high school vocational training programs in the U.S., only 43 percent of the employed graduates in their early 20s had a training related job (broadly defined) in the 1985 National Longitudinal Survey of Youth (Campbell et al., 1987). Other studies of high school vocational education using the same methodology obtain similar results (Felstehausen 1973; Conroy and Diamond 1976). The proportion of Comprehensive Employment and Training Act program graduates whose occupational field 12 months after completion of classroom training matched their field of training was only 41 percent for clerical training, 39 percent for training in operative occupations and 29 to 32 percent for professional and craft training (Barnow 1985). A recent GAO report also indicates that most Job Corps graduates do not find jobs in the field for which they trained. When, on the other hand, employers provide occupational training, it is more likely to be used. Mangum and Ball (1986) found in their analyses of NLS data that employer controlled training institutions have higher training related placement rates.

A second advantage of on-the-job learning is the strong motivation to learn that is engendered by the high probability of using the skills learned and the promotions and pay increases that go to those who do well in training. Third, employer training is generally

tutorial in nature and this is known to be an effective though **costly** teaching method. Fourth, employer training is generally done by supervisors and coworkers who are aware of the trainee's progress and can give necessary corrective instruction. Fifth, the equipment and materials necessary for the training are generally readily available at the work site and time on the machine for the trainee can generally be arranged without disrupting production. When schools provide the training, equipment must be specially purchased and keeping the equipment up-to-date is often very expensive. Sixth, the trainer (not just the trainee) is held accountable for success since the training is designed to increase productivity and supervisor/trainers are held accountable for the productivity of the work group. Finally, when employers provide training the trainee's time tends to be used much more efficiently. Both the trainer and trainee are being paid, so hourly costs are high. The employer also receives most of the benefits. This gives employers a strong incentive to select cost effective training strategies. Schools, by contrast, neither pay the time costs of the trainee nor benefit directly from the skills that are developed, so they have a weaker incentive to select teaching strategies which economize on trainee time.

Consistent with these theoretical arguments, short spells of employer sponsored training often have remarkably large effects on productivity (Bishop 1992).

6.3 Under-Investment in Employer Training

The problem with employer training is, thus, not a lack of effectiveness. Indeed, it is generally very effective. The problem is that there is too little of it. Indeed the high social rates of return to employer training just cited are a consequence of under investment. Many of the benefits of training go to individuals who are not a party to the decision to undertake it. It's major beneficiary--the worker--is often poorly informed about costs and benefits and lacks the resources and the access to the capital market necessary to pay for it. Government regulations often get in the way. Because of these barriers, training is undertaken only when it is expected to yield extremely high returns. That is the fundamental reason why the benefits of the general employer training that does occur are many times larger than their costs.

Employers and workers under invest in employer training for six reasons.

(1) Federal Wage and Hour regulations present employers with the following

dilemma: either (a) don't provide training in general skills like reading or word processing that will improve a worker's productivity in their current job or (b) provide such training and pay **all** of its costs--instructional costs and trainee time costs. No matter how general the skill nor how voluntary the decision to take training, if it raises productivity in one's current job and is provided by the employer, federal regulations require that the employer pay the full salary while the employee attends a class at work. Workers and employers are prohibited from cutting the following deal--the company will provide on-site opportunities for learning general skills useful in one's current job which workers may volunteer to participate in during uncompensated time (Bureau of National Affairs 1993, 97:3208). If such cost sharing arrangements were legal, many employers who currently do not offer training programs because of the fear of turnover would initiate such programs.

(2) Poor Signalling of General Skills to Other Employers: The training provided by one employer benefits other employers and consumers, not just the trainee and his/her employer (Bishop 1994). The worker is more productive in future jobs, but these employers do not perceive accurately the quality of the general OJT received by the worker and, as a result, do not fully compensate the trained worker for their higher productivity (Bishop 1994). This, of course, reduces the worker's willingness to invest in training. Worker risk aversion also makes workers reluctant to invest in training.[11]

(3) Discoveries and Disasters Attributable to Training: High quality training benefits customers and the public as well as the trainer and the trainee. When, for example, the dancers of the New York City Ballet receive excellent training, the company benefits through greater ticket revenue but the audience benefits as well because they derive a larger consumer surplus from the performance. The Aloha airlines pilot who landed his plane after an explosive decompression and the loss of a major section of his plane, certainly raised the lifetime earnings of his passengers. Training and experience were critical to the safe landing of the Aloha plane. When, on the other hand, a worker screws up because of poor training, the customers and the general public often lose just as much as the worker and the company. Examples of disasters contributed to by poor training are legion: Chernoble, Three Mile Island, Exxon Valdez (a poorly trained mate was piloting the ship) and the shoot down of the Korean Airlines 747 (pilot error caused the plane to be off course). Tort law internalize some but not all of these costs of inadequate training.

(4) The Non-Deductibility of Some Training Expenses--The benefits of training are taxed, but not all of the costs are deductible.[12] Some of the time that trainees devote to employer sponsored training comes from reducing leisure time. Reductions in leisure time are not deductible.

(5) High Borrowing Costs and Liquidity Constraints--Because of the fear of turnover, employers are reluctant to pay for general training that is visible to and useful at other firms. If the employer is not willing to pay for general training, it will be offered only to those workers who pay for it by accepting a lower wage during the training period than could be obtained elsewhere. The more intensive the training, the greater the required reduction in wages will have to be. Many workers are unwilling to accept a large reduction in their current standard of living, and, since they are unable to borrow at reasonable interest rates, they forego the investments in general on-the-job training. If they do fund such investments, they do so only if extremely high rates of return are obtained. Because they have more favorable access to capital markets and can spread risks over many workers, firms are often more willing to make investments in training than workers.

(6) Employers Share the Costs of General Training It is now clear that many employers pay at least part of the costs of the general training of their employees. We know this to be the case because workers receiving training are not paid appreciably less than other similar workers and new hires who require extra training are paid only slightly less than new hires who require less than average amounts of training (Bishop and Kang 1984, 1988, Parsons 1985, Bishop 1994, Barron, Berger and Black 1994). Many employers offer workers the opportunity to learn general skills such as word processing and other computer applications programs on company time. Studies of the costs and benefits of apprenticeship training programs find that employers do not recoup their investment during the apprenticeship contract. Clearly, employers are sharing the costs of general training.

If employers are paying some of the costs of general training, they are not doing it for altruistic reasons. They are comparing the training costs incurred to the expected productivity benefits the firm will receive from the workers who stay at the firm. Benefits received by other employers and by the trainee will have zero weight in their calculation. **Thus, turnover causes the firm to take only a portion of the true social benefits of general training into account. The result, inevitably, is under-investment in employer provided**

training that develops general skills.

6.4--If School-based Training were Eliminated: What would Happen?

If schools were to withdraw from the occupational training market, the economy would have to depend on employers to provide occupation specific training. At present they under invest in this type of training. How would they respond to being given the whole responsibility?

Since separation rates are high for most companies, employers would not be willing to take over this task without some inducement. Government could offer employers training subsidies, but such a scheme would be difficult to administer and would probably cost more than the current school-based occupational training system. In the absence of massive subsidies of employer training, shortages of skilled labor would develop and wage premiums for occupational skills formerly learned in school would rise. Lacking immediately useful skills, school leavers would find it more difficult to get work and have to accept lower wage rates. Some employers would substitute less skilled workers for the now more expensive skilled workers (eg. LPNs replacing RNs in hospitals) and let the quality of the service they provide deteriorate. Others would find ways to substitute machines for people or arrange for workers located in other countries to do it (eg. many companies have set up software writing subsidiaries in Bulgaria, Russia and India). Eventually, the scarcity of skilled workers would become so severe and the wage differential between unskilled and skilled workers so large, that employers would find it has now become profitable to provide occupational skills training. In the new equilibrium, however, the society would have fewer skilled workers, a lower standard of living and a more unequal distribution of earnings.

7. Is Occupation Specific Training Becoming Less Necessary Because of Escalating Turnover and Skill Obsolescence?

It is sometimes argued that high school students should now concentrate on academic courses rather than occupational skills because jobs are changing more rapidly than in the past with the result that occupational skills learned in school become obsolescent more

rapidly than in the past. Rates of turnover and skill obsolescence are now so high, The Economist argues, that occupationally specific skills are no longer good investments for young people. Let us break this argument down into its three parts and examine each one.

- Has turnover increased? What effect has changes in turnover had on the social payoff to occupation specific training and employer willingness to invest in training?
- Has skill obsolescence increased? What effect does high rates of skill obsolescence have on the social payoff to occupation specific training?
- Has the payoff to investments in occupation specific skills declined in recent years?

7.1 Turnover

Job turnover has indeed increased over the last 25 years. The proportion of the work force with fewer than 25 months of tenure at their company rose from 28 percent in 1968 to 40 percent in 1978 and has remained high since then (see row 1 of Table 6). Tenure of male workers fell 5 percent between 1963 and 1981 (holding age composition constant) and then fell another 8 percent between 1983 and 1987.[13] The 1983 to 1987 decline in tenure was particularly pronounced for males working in clerical, retail sales and management related occupations (eg. accountants, personnel, financial officers and management analysts). Tenure actually rose in only two industries--professional services and public administration--and one occupation--technicians (BLS 1983, 1987). Even in high skill occupations, tenure now appears to be remarkably low: a median of 4.3 years for technicians and sales representatives in wholesale and manufacturing, 5.5 years for craft workers, 5.7 years for professionals, 5.3 years for management related occupations, and 6.5 years for general managers outside of government (Maguire 1993).

While job turnover has increased for males, **occupational turnover has decreased**. When age and gender are held constant, rates of occupational mobility for men fell 20 percent between 1966 and 1987 (see row 4 and 5 of Table 9). The occupational mobility of women increased from 1966 to 1978 and then declined from 1978 to 1987. During 1986 over 90 percent of occupational changes by women (and 84.4 percent of the changes by men) were self initiated and not made necessary by a layoff, dismissal or plant closing

Table 6
Trends in Job and Occupational Turnover
(holding age and gender constant)

	1951	1963	1966	1968	1973	1978	1981	1983	1987	1991
% with Tenure LT 25 mo	38.1%	33.2	25.4	28.2	37.8	39.9	39.3 |	38.5*	40.1*	40.4*
Median Job Tenure										
Men-avg. 20-64	5.1	7.6	7.9	7.3	7.4	7.2	7.2 |	8.4*	7.7*	---
Women-avg 20-64	3.0	4.1	4.2	3.8	4.3	4.1	4.3 |	5.6*	5.4*	---
Occupational Turnover (annual)										
Men 20-65+	---	---	10.2%	---	8.6%	10.1%	8.9%	8.2%	8.2%	---
Women 20-65+	---	---	6.3%	---	7.2%	9.6%	9.3%	8.3%	8.4%	---

* The wording of the question changed in 1983, so there is a break in the series at that point.
The first row is the share of all workers over age 16 with fewer than 25 months of tenure (OECD 1993 Table 4.1; Hamel 1963, 1967; Hayghe 1974; Horvath 1981; O'Boyle 1969; Sekscenski 1979; BLS Jan 1983, Jan 1987). For years 1951 through 1981, rows 2 and 3 are unweighted averages of the median tenure in January of the year indicated reported for five age groups: 20-24, 25-34, 35-44, 45-54 and 55-64. For 1983 and later, row 2 and 3 are mean tenure levels unadjusted for age. The fourth and fifth rows are unweighted averages of BLS occupational mobility rates for six age groups: 20-24, 25-34, 35-44, 45-54, 55-64 and 65 and over. These rates are the number of workers who were in a different occupation the prior year as a proportion of those employed in both years--January of the year indicated and the previous January (Markey and Parks, 1989 Table 1). They is based on the following sequence of questions. "Was ... working in January [one year previously]? ....If yes..."You told me that ...is now working as a ...[occupation reported for January 16, 19..]? Was...doing the same kind of work a year ago, in January 19..?" As a result, occupational turnover estimates are not inflated by errors in measuring occupation.

(Markey and Parks 1989 Table 2). Thus the rise in occupational mobility of women is not bad news; it is the result of improved opportunities for advancement. The number of women with professional and managerial jobs has doubled since 1979. Current levels of occupational turnover are considerably lower that those experienced by the generation that lived through the depression, the mobilization for World War II and the rapid demobilization after the war. Occupational turnover is high in the United States, but it has always been high.

To summarize, over the last 17 years job turnover has increased, while occupational turnover has decreased. These two facts do **not, however,** imply that schools should scale back occupational training, leaving this function to employers. **Rather they imply exactly the reverse.** Social returns to occupational training (and the worker's private returns) are influenced by occupational turnover, not job turnover. The decline in occupational turnover for men and more recently for women means **the social returns to occupational skills**

training have increased. At the same time, **the rise in job turnover has eroded incentives for employers to invest in occupational skills training**. Under investment in occupational training by employers has, therefore, almost certainly increased.

7.2 Skill Obsolescence

While hard data on the issue is lacking, employers report that new skills are replacing old skills more rapidly than in the past. Skill obsolescence has increased. This **does not**, however, imply that rates of return to occupation specific skills must fall? Skill obsolescence is greatest in fast changing fields close to the frontier of knowledge. It is in precisely these fields where the payoff to skill development is the greatest. Yes, high obsolescence means the payoff period is short. But it also means that the supply of workers with the new skills is small because previous generations of trainees did not learn them. Thus graduates of training programs which impart the latest skills have something which is in short supply and which will therefore be well rewarded. This is the primary reason why engineers receive high starting salaries and violinists do not.[14] Each violinist graduating from Julliard competes with fifty years worth of graduates of Julliard and other schools. Newly minted engineers, by contrast, have skills not taught to earlier generations, so they are competing primarily with others of the same vintage, not with the previous fifty years worth of engineering graduates. The labor market responds to high rates of skill obsolescence by paying a higher premium for the skill.

Thus those who argue that high rates of skill obsolescence imply a reduced need for occupation specific skill development have it exactly backwards. Obsolescent skills must be replaced by new skills. **If skills become obsolete more rapidly, then new skills must be learned more frequently. This implies greater needs for occupational skill development, not reduced needs.** If employers cannot be persuaded to increase training, schools must do it.

High rates of skill obsolescence mean, of course, that schools must work hard to keep their training up-to-date. They also imply that workers will need to update their skills continuously. What is the best way to prepare now for having to learn new skills five or ten years in the future? It depends of course on what type of skills you expect to have to learn. If you believe workers will need to write proposals or reports, preparation should presumably focus on these types of writing rather than literary criticism. Everyone is likely

to need to learn new computer programs. The best way to prepare now to learn future versions of an applications program is to learn the current version.[15]

The spread of information technology and of high performance work systems is making some old skills obsolete, but the new occupational skills that must be learned are often additions to, not replacements for, old occupational skills. While learning a new skill is easier when the worker has good basic skills, a foundation of occupational skills and generic technical and computer skills are generally even more essential.

7.3 Direct Evidence of Rising Returns to Skill

Other types of evidence also contradict the contention that returns to occupation specific skills have fallen. The wage premiums paid for technical and occupational skills developed in non-baccalaureate programs have been rising for the last decade. Male craft workers are now paid 35.3 percent more than operatives; in 1983 they were paid only 25.6 percent extra. Female clerical supervisors are now paid 37 percent more than other clerical workers; the premium used to be 29 percent. Secretaries are now paid 61.5 percent more than maids, a substantial increase from the 49 percent premium that prevailed in 1983.

What about job growth and availability? There is no foundation to the complaint that most new jobs require no skill. The most rapidly growing occupations require more than average amounts of skill and training. **Managerial, professional and technical and high level sales jobs accounted for 67 percent of the 6,728,000 increase in jobs between November 1989 and November 1994.**[16] These occupations now account for 37.6 percent of all workers. Service occupations accounted for only 21 percent of job growth. Sales workers in retailing and personal services accounted for only 3.4 percent. While managerial and professional employment grew 50 percent since 1982 and technical jobs grew 30 percent, janitorial jobs grew only 7 percent, food service jobs grew 21 percent, clerical jobs grew 14 percent and operative and laborer jobs grew 10 percent (BLS 1984 1994). The unemployment rate of managers and professionals never exceeded 3.5 percent during the 1992 recession and has now fallen to 2.2 percent in November 1994. By contrast, November 1994 unemployment rates were 7.5 percent for service workers and 7.7 percent for operatives and laborers.

Knowledge is Power
--Francis Bacon, "De Haeresbis" Meditationes Sacrae, (1597)

PART III
THE IMPACTS OF VOCATIONAL TRAINING ON LEARNING

Since occupational competence is the primary objective of vocational programs, it would be reasonable to hypothesize that students who participate in these programs should score better on job knowledge tests, should be rated as better employees by supervisors and should receive higher earnings than students who took no vocational courses in school. Is this indeed the case? It is to these questions we now turn.

8. Vocational Courses Raise Job Knowledge

Vocational education programs have substantial effects on job knowledge. The findings of two studies comparing occupational competency test results of students at various stages of their training are reported in Table 7. The first column of the table reports the differences between trained and untrained students on the occupational competency tests developed by American Institutes of Research (1982) under a contract with the Office of Vocational and Adult Education. The second column reports the difference between Ohio high school juniors and seniors on most of the competency tests available from the Ohio Vocational Education Achievement Test Program. Since the tests are normally given in the spring, this column is an estimate of the gain in competency that occurs between the end of the first and the end of the second year of a high school vocational program (Instructional Materials Laboratory 1988). Mean differences have been put into a common metric by dividing them by the sample standard deviation of the program completers who took the test. While some of the mean differences are less than a third of a standard deviation, most are over half of a standard deviation and some are substantially greater than one standard deviation. The difference between sophomores and juniors and between juniors and seniors on academic achievement tests are generally between 20 and 30 percent of a standard deviation in the final years of high school. Thus, when test standard deviations are the metric of comparison, vocational education appears to produce larger gains (on a narrower

Table 7
Effects of Vocational Education on Occupational Competency

Occupation	AIR Trained Versus Untrained	Ohio Seniors Versus Juniors
Word Processing Specialist	88%	43%
Computer Operator	137	--
General Office Clerk	--	--
Clerk Typist	--	34
Grocery Clerk/Food Marketing	21	27
Apparel Sales	22	86
Dental/Medical Assisting	166	63
Restaurant/Food Service	26	25
Electronics Technician	111	--
Water Treatment Technician (avg)	132	--
Diesel Mechanic	132	47
Carpentry	76	60
Construction Electricity	--	63
Drafting	--	51
Machine Trades	--	47
Welding	--	67
Cosmetology	--	63

Source: Table reports estimates of mean competency test score differences between students at different stages of an occupational training program divided by the standard deviation of program completers. Column 1 is from American Institutes of Research's (1982) report on the Vocational Competency Measures it developed under a contract with the Office of Vocational and Adult Education. Samples ranged from 100 to 296 for the trained students and from 24 to 51 for the untrained students. These tests are now available from AAVIM in Athens Ga. Column 2 gives the mean differences between Ohio high school seniors tested in the spring of the year and juniors also tested in the spring of the year (Instructional Materials Laboratory, 1988).

front to be sure) than the academic side of high school.

Selective attrition and maturation effects are probably contributing to the differences in competency between trained and untrained individuals (and also between sophomores and seniors on academic achievement tests). Consequently, the true value added of vocational programs is probably somewhat less than the numbers reported.

7. Does Studying Occupationally Specific Skills in School Lower Achievement in the Academic Arena?

Since the total number of courses that one can complete during high school is limited, taking vocational courses restricts the number of academic courses one can take, and vice versa. Does this mean that developing occupationally specific skills in high school implies diminished basic and academic skills? At first glance it would appear that vocational education is having such an effect. There are large test score differences at the end of high school between vocational and academic students. The gap is about one standard deviation or about 3.5 grade level equivalents. Much of this gap, however, preexisted the student's entry into vocational education (Kulik 1994). Indeed students who have difficulty with academic subjects often seek out vocational courses precisely because they offer a different setting and different modes of learning.

Table 8 presents estimates of test score differentials between academic, vocational and general students taken from two early studies (Hilton 1971 and Evans and Galloway

Table 8
Achievement of Vocational, General and Academic Students

	Hilton 1971			Evans and Galloway 1973		
	Vocational	General	Academic	Vocational	General	Academic
Early	-.55 (29)	-.61 (27)	.50 (69)	-.47 (32)	-.26 (40)	.69 (76)
Late	-.60 (28)	-.63 (26)	.47 (68)	-.52 (30)	-.31 (38)	.80 (79)
Gain	-.05	-.02	-.03	-.05	-.05	.11

Source: Table 4.2 of Kulik 1994 summarizing results in Weber et al (1982). The numbers represent the deviation of one group of students from the national mean in a national standard deviation metric. Number in parenthesis are the percentile scores for each group.

1973) which provide the data necessary to calculate gains in achievement during high school. They are taken from Kulik's excellent review of the research on the educational effects of vocational education. In Hilton's (1971) data, gains on the academic tests were almost identical for vocational, academic and general students. In Evans and Galloway's (1973) data, academic students improved 16 percent of a standard deviation (or about two-thirds of a grade level equivalent) more than vocational and general track students. Neither study found that vocational students lost ground on general students. Haney and Woods's (1982) examination of longitudinal data on students who graduated from high school in the early 1960s also found "no support for the proposition that the basic skills learning of secondary vocational program students is any less than that of general program students."

Longitudinal data are essential to assess the true impact of vocational course taking. Regression based studies were also reviewed by Kulik (1994) and the results are presented in Table 9. When pretest scores and demographics are controlled, the relationship between vocational education and academic test scores becomes much weaker. Thus, self-selection is responsible for most of the differences between vocational and academic students. Kulik (1994) concluded that "80% of the difference in test scores of academic and vocational students at the end of high school is due to the difference in aptitude of the students who enter the programs (p. 47)."[47] Rasinski's (1994) analysis of NELS-88 gets similar results.

Table 9
Effects of Vocational, General and Academic Programs on Academic Achievement
(Estimates Based on Regression Analysis of Longitudinal Data)

Study	Vocational	General	Academic	Non-Academic
Controls for Pretest but not Course Work				
Jencks and Brown 1975	----	----	.03 (51)	-.03 (49)
Alexander, Cook & McDill 1978	----	----	.10 (54)	-.15 (44)
Alexander and Cook 1982, eq. 2	----	----	.05 (52)	-.12 (45)
VanFossen, Jones & Spade 1987, eq. 8	-.20 (42)	-.08 (47)	.15 (56)	-.12 (45)
Gamoran, 1987, eq 5a	-.11 (46)	-.04 (48)	.12 (55)	-.09 (46)
Controls for Pretest & Course Work				
Alexander and Cook 1982, eq. 8	----	----	.01 (50)	-.03 (49)
Gamoran, 1987, eq 5c	-.08 (47)	-.02 (49)	.08 (53)	-.06 (48)

Source: Kulik 1994, Table 4.3. Results are in z-score form; percentile equivalents are in parenthesis. Impacts in grade level equivalents can be approximated by multiplying by 3.5.

Vocational students were behind general track students in 10th grade, but closed the gap by 14 percent of a GLE in science and 27 percent of a GLE in reading by the end of 12th grade. Relative to academic students the vocational students fell a further one-half of a GLE behind in mathematics and a further 28 percent of a GLE behind in science, but lowered the reading gap by 15 percent of a GLE (Rasinski, Tables 6a-6f).

The following analysis of the cohort of High School and Beyond students who graduated in 1982 illustrates how curriculum affects academic learning. The dependent variables were the change between sophomore and senior years in test scores, grades, career plans, key attitudinal variables such as self-esteem and locus of control, and an index of student deportment (Bishop, 1985). The model included extensive controls for variables that may influence both curriculum and the outcomes.[18] These included an array of socioeconomic background variables, base year grades, test scores, attitudinal variables, base-year educational and occupational expectations, and parents' career expectations for their children. Numerous measures of curriculum were used to assess curriculum effects, including base-year, self-reported curriculum track (vocational and academic), self-reported number of courses taken between the sophomore and senior year in a variety of subjects, and dummies variables for taking specific courses--algebra II, trigonometry, calculus, physics, chemistry, biology, an honors English course, and an honors math course.

These analyses show that curriculum has a strong influence on many of these outcomes, but traditional measurement of curriculum by reference to track placement does not capture these effects. The traditional track variable (self-reported membership in the academic or vocational track) had little or no impact on any of the outcomes (not shown). When, however, specific course descriptions were used (e.g. algebra II, physics), the effects of taking a college preparatory curriculum of calculus, trigonometry, algebra II, physics, and chemistry were striking (see table 9).

Holding the total number of academic courses and their distribution across fields constant, taking the 5 college preparatory math and science courses listed above raised math and science performance by 75 percent of a grade level equivalent (GLE), verbal test scores by 33 percent of a GLE, and civics test scores by 44 percent of a GLE.[9] Self-esteem, deportment and occupational and educational aspirations were also raised substantially. If a student takes 3 additional year-long math and science courses but avoids the more

Table 10

Change in Academic Achievement
Resulting from Modifying Curriculum

(in Percent of a Grade Level Equivalent)

Achievement on	Taking Rigorous College Prep Courses	Taking 3 Additional Courses in Math & Science	Taking 3 Additional Courses in Business & Office	Taking 3 Additional Courses in Technical
Verbal Test	34%***	-1[illegible]%***	20%***	4%
Math Test	76%***	19%***	-9%	15%**
Science Test	74%***	- 9%***	- 6%	-1%
Civics Test	44%*	-18%***	+15%**	1%
GRADE POINT AVERAGE	-.12**	0.0	.06**	.05*

Source: Entries are averages of coefficients from seperate regressions for males and females. For the four test scores, entries are coefficients scaled as a percent of a grade level equivalent under the conservative assumption that the test's standard deviation is equal to 3 grade level equivalents. The results for GPA are in percents of one point on a 4 point GPA scale. The dependent variable was the change between the end of sophomore and senior years. The models used to derive these estimates contained a total of 75 control variables. Included among the control variables were the sophomore values on the 10 other outcome measures, a great variety of specific courses, years of courses in specific subjects taken during freshman and sophomore year and during junior and senior year, family background, self-assessed ability to succeed in college, and parental pressure to attend college.

*Statistically significant at the 95 percent level.
**Statistically significant at the 99 percent level.
***Statistically significant at the 99.9 percent level.

rigorous courses listed above and does not change the number of courses taken in other fields, math test scores increase by 19 percent of a GLE, but verbal and civics test scores decline by an almost equal amount. Self-esteem and career aspirations did not change. Deportment and educational plans improved modestly.

The results indicate that vocational courses sometimes contribute more to the development of basic skills than watered down courses in academic subjects. Holding constant the academic course load and the dummies for the 5 courses indicating a college prep curriculum, taking 3 full-year business and office courses raised civics and verbal test scores by 15 to 20 percent of a grade level equivalent. It also improved deportment, self-esteem and educational plans. Taking 3 full-year courses in the technical area raised math performance by 15 percent of a GLE. Trade and industry courses and the residual category of vocational course had small negative effects on test score gains.

Why do rigorous college preparatory math and science courses have such salutary effects on a whole range of tests? The crucial difference is apparently that these college preparatory classes are more demanding than other classes. This is clearly the case in our data, for the students that took all 5 of the college preparatory classes got significantly lower grades than those who took other courses in these fields. Apparently the key determinant of learning is the rigor of the courses taken, not the total number of academic courses or the total number of hours spent in a school building during a year. Thus, vocational students learn less mathematics and science than many academic students primarily because they take less demanding academic courses, not because they take fewer academic courses.

Kulik concludes similarly, that "if vocational students were similar to academic students in aptitude and took the same number of advanced courses in core subjects, the achievement gap would be no more than 0.1 standard deviations (p. 47)." In senior high school a tenth of a standard deviation is only about a third of a grade level equivalent.

The next part of the paper reviews the evidence on the level of and trends in the payoff to occupation specific training provided in high schools and postsecondary institutions.

The same man cannot well be skilled in everything;
each has his special excellence.
--Euripides, Rhesus, tr by Richard Lattimore (455-443 B.C.)

PART IV
IMPACTS OF SCHOOL-BASED OCCUPATION SPECIFIC TRAINING on PRODUCTIVITY AND WAGES

Excellence is impossible without specialization.

Occupational training increases productivity and helps trainees in four different ways.

1. First and foremost, training raises the trainee's productivity and wage rates (and lowers in-house training costs) in specific jobs. In some cases the job cannot even be attempted without the training (eg. licensed occupations). In order for this direct productivity enhancing effect to be realized, the worker's training must have some match with their subsequent jobs. This effect will be referred to as the **within-job productivity effect**.
2. Hiring already trained workers also brings knowledge and skills to the firm that in many cases no one currently in the organization or work group has. Hiring trained workers can thus be part of the firm's strategy for remaining abreast of technological developments. The new skill brought to a firm by a new hire may enable it to improve the quality of its service or to enter new markets. The new employee may be able to train other employees. This effect will be referred to as the **technology-skill-transfer effect**.

When training has one or both of these direct productivity enhancing effects, two secondary effects are generated.

3. Because of their lower training costs, higher productivity and the prospect of discovering ways of improving productivity, employers generally prefer to hire workers with relevant training and experience. This is particularly the case when jobs

are complex and training is costly. This then results in individuals with training in high-demand occupations getting higher-wage higher-productivity jobs that offer better opportunities for training and advancement. This will be referred to as the **job access effect**. If the total number of jobs in the field were fixed, this job access effect would result in training program graduates displacing untrained job applicants. But the total number of good jobs is not fixed. A large supply of well trained workers lowers the true cost of filling positions in the field and this induces expanded hiring. Effective occupational training programs can also influence plant location decisions--eg. Mercedes Benz's decision to build cars in South Carolina rather than Germany or Mexico.

4. Occupational training typically increases the graduate's commitment to the labor force, lowers turnover and reduces unemployment. Job finding rates are higher because graduates are more marketable and have been taught effective job search skills. Separation rates are lower because job quality has improved and the worker's skills make layoffs more costly for the firm. Since work experience directly enhances productivity, the tendency of occupational training to increase employment has important positive long run effects on wage rates and earnings. These phenomena will be referred to as the **job-stability effect**.

Let us begin by examining the first two effects-- the within-job productivity and technology transfer effects--of school-based occupational training. For this we need a data set relating workers previous training to their employer's perception of their skills and productivity, their wage rates and suggestions for improving productivity of individual workers.

10. The Effect of School-based Occupational Training on Employer Assessments of Skills

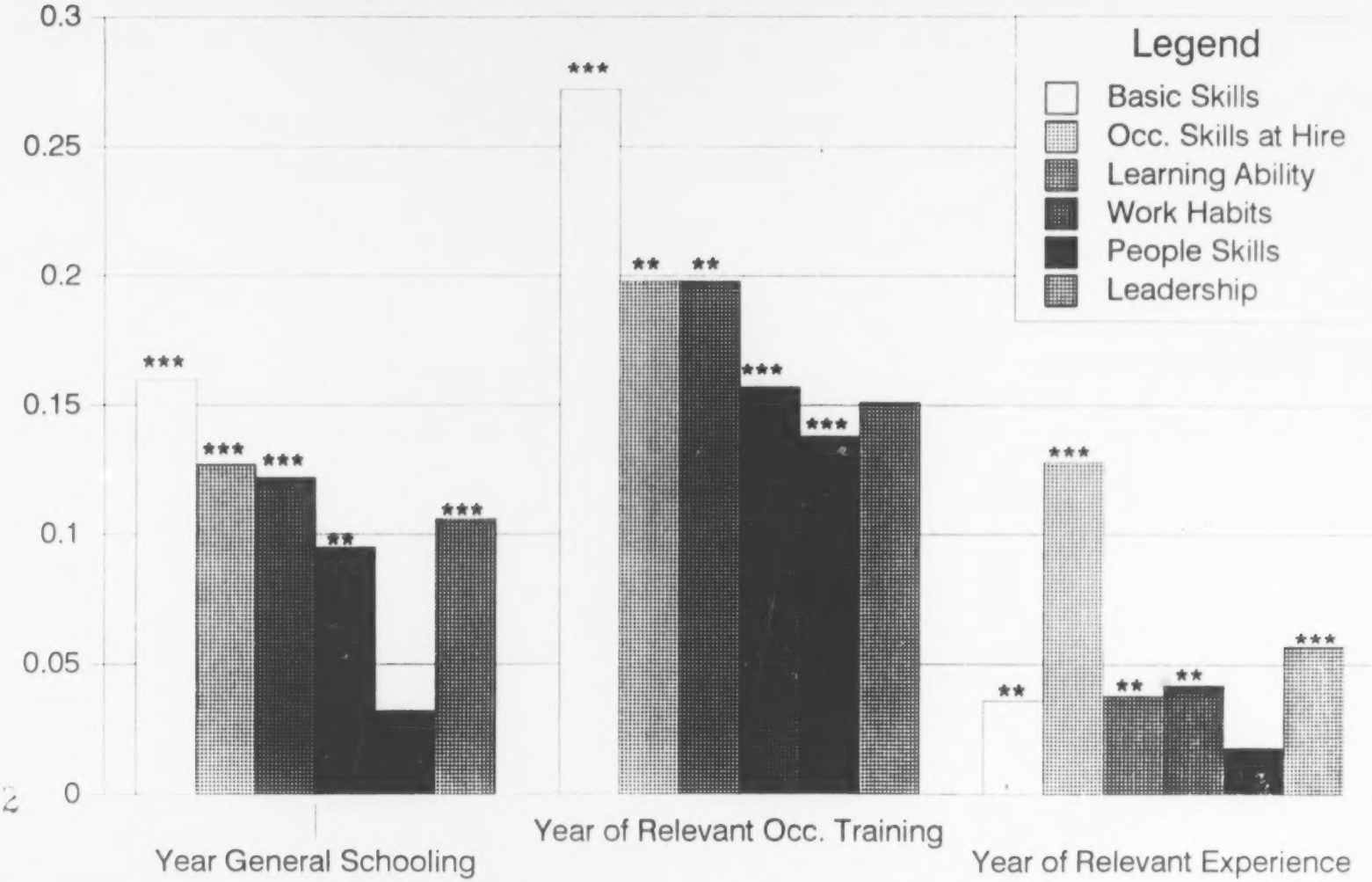
How does vocational education affect employer assessments of worker skills? The NFIB data analyzed in section 1 and 2 allows us to examine this issue. Models were estimated predicting the ranking of two occupants of the same job on six different

dimensions of ability and job performance--occupational skills, basic skills, learning ability, work habits, people skills and leadership. These rankings were modeled as a function of differences in years of schooling, years of relevant vocational schooling, years of relevant work experience, formal company training and demographic characteristics.[19] These objective characteristics of the new hires explained very little of the variation in rankings of work habits, people skills, learning ability and leadership. Predicting these outcomes the R squares ranged from .0187 to .0561. The traits that were most predictable were occupational skills and basic (reading, writing and math) skills. Adjusted R squares were between .10 to .11.

Estimates of the impact of general schooling, relevant vocational schooling and relevant work experience on employer assessments of worker skills are presented in Figure 6. The bars on the right hand side of the figure characterize the impact of one year of relevant work experience on employer ratings of skill differentials between two workers doing the same job. The bars on the left hand side of the figure represent the impact of one year of additional general education on employer ratings of worker skills. The *'s above these bars indicate whether the estimated effects of work experience or general education are significantly different from zero.

The middle set of bars characterize the impact of one year of occupationally relevant school-based training on employer ratings of relative skill levels. The impact of vocational training on skill rankings is significantly greater than zero for all six skills. The *'s above the bars for occupational training report the results of a different hypothesis test: whether a year of occupational training has a bigger impact on ratings than a year of general schooling. While general schooling has significant positive effects on five of the six skill dimensions, a year of relevant training at a school has a significantly larger effect. Relevant occupational training not only raised rankings of occupational skills, it significantly raised rankings of the worker's basic skills (reading, writing and mathematics), learning ability, work habits and people skills. Leadership was the only trait for which it was not possible to reject the hypothesis that general and occupation specific education had equally positive effects on the skill. These results suggest that obtaining vocational schooling <u>that ends up being relevant to your job</u> substantially improves employer perceptions of your work habits, people skills, basic skills, occupational skills and learning ability.

Figure 6
Impact of Schooling and Experience on Employer Assessments of Skills



How do the impacts of relevant vocational schooling compare to the impacts of relevant work experience at another company? This is answered by comparing the middle and right hand set of bars. Clearly, a year of relevant occupational schooling has larger effects than a year of relevant work experience. For five of the six skills/traits, the estimated impact of a year spent in a vocational school was three to five times larger than the estimated impact of a year of relevant work experience. Only for "occupational skills at hire" were the effects of relevant work experience large enough to make the two forms of skill development somewhat comparable.

11. Effects of Occupational Training on Productivity and Technology Transfer

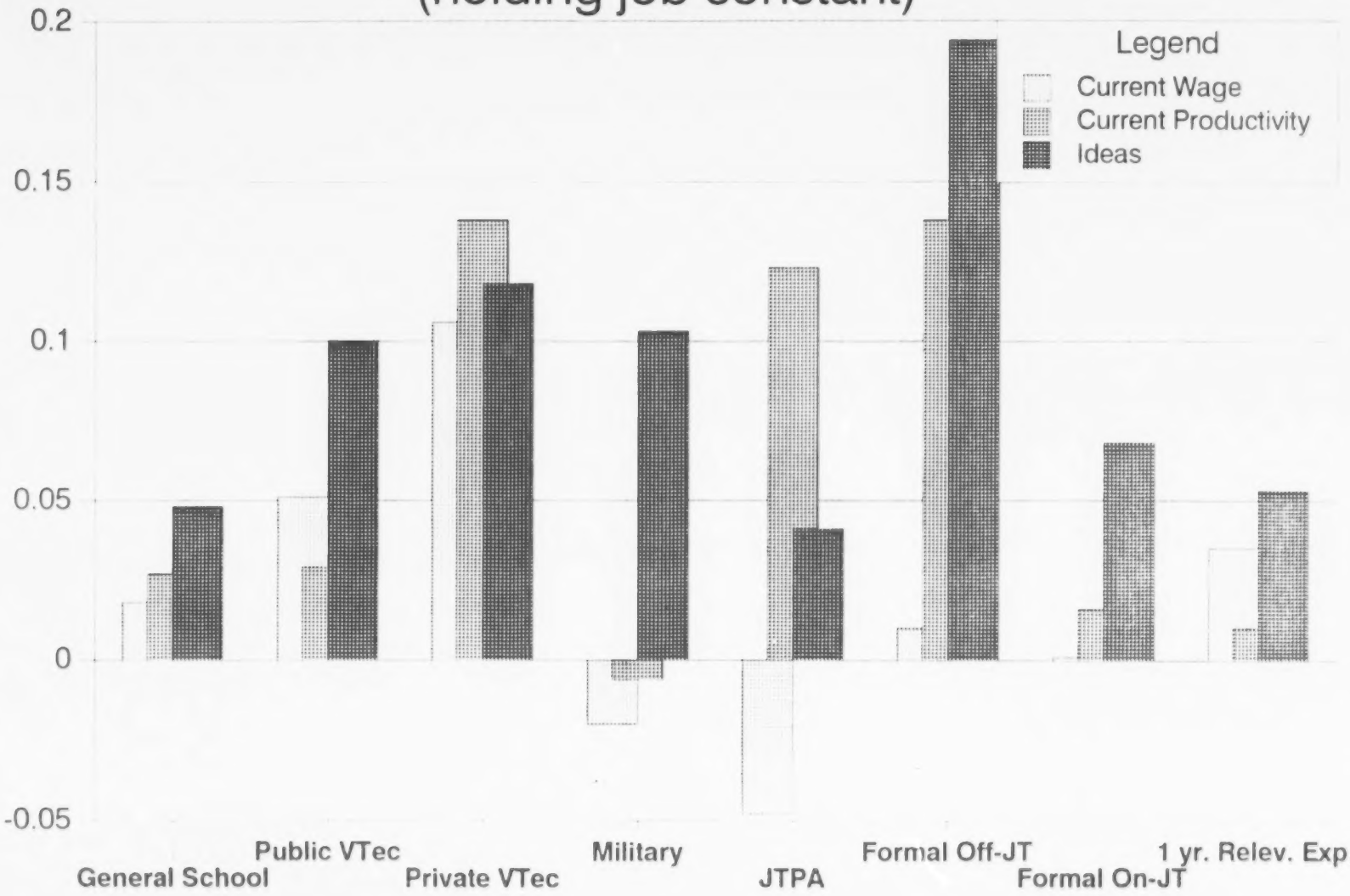
Are new hires who have had previous training in an occupation more productive and better paid than those doing the same job who have no previous training? Are they more likely to suggest ways to improve the operation of the firm? Does relevant training obtained at a school have larger or smaller effects than training obtained from previous employers? Which types of voc-tech schools appear to be most effective? One way to address these questions is to compare two individuals at the same firm in the same job and see how differences in reported productivity and wages are related to differences in previous training. The NFIB data previously discussed has the necessary information on two newly hired workers, so this is the approach I take here.[20]

The findings are presented in Figure 7. We will examine two outcomes--current relative wage rates and current relative productivity--which capture **within-job productivity effects.** The heights of the bars represent the proportionate wage rate or productivity differential associated with a year (or less) of each particular type of previous training.

The third outcome examined captures **technology transfer effects**. The NFIB employers described how many suggestions for improving productivity or sales were made by each of two new hires recruited about one year previously. An ideas index was created from this question. If no suggestions were made, its value was zero. If a suggestion was made but not adopted, the individual was assigned a 0.5 on the index. If

Figure 7

Effects of Occupational Training on Wages & Productivity (holding job constant)



one or two suggestions were made and adopted, the individual was assigned a 1.0 on the index. More than two suggestions adopted generated an index value of 1.5. The index has a mean of .5 and a standard deviation of .55. The dependent variable was the difference between the ideas index of two different workers recently recruited into the same job.

Holding the job constant, workers with one additional year of regular schooling were 3 percent more productive, paid 1.3 percent more, and about 4.5 percentage points more likely to make a suggestion that was adopted. Having at least one year of relevant occupational training from a public school or college had an equal effect on productivity, but wage rates were 5.9 percent (rather than 1.3 percent) higher and the probability of adopted suggestions rose 11 percentage points (rather than 4.5 points). The products of private vocational-technical colleges were even more successful. They were about 12 percent more productive, 12 points more likely to have a suggestion adopted and paid 10 percent extra.

The right hand side of the figure presents estimates of the effects of training sponsored by previous employers. The bars for relevant work experience capture the effect of informal training and learning by doing that varies with time in relevant jobs. An additional year of relevant work experience raises productivity during the first few weeks on the job about 3 percent (not shown). A year after hiring, the effect falls to 1.5 percent per year of relevant experience. However, the probability of making suggestions that were adopted was 3.4 points higher per year of relevant experience and wage rates were 2.5 percent higher.

Workers who had received relevant formal training from a previous employer did not get paid significantly more. When, however, the training was off-the-job (probably in many cases at a school), productivity was 10.2 percent higher and **the probability of adopted suggestions rose by 19 percentage points**. Formal training received on-the-job from a previous employer had no statistically significant effects on productivity or suggestions.

In summary, when job is held constant, job relevant training obtained from schools or colleges has important effects on an employee's relative wage rate, relative productivity and the propensity to make suggestions that are adopted. The graduates of

private vocational-technical schools and workers sent to off-the-job training by a previous employer are particularly productive and particularly likely to make suggestions. This pattern suggests that productivity impacts are greatest when employers and voc-tech schools collaborate very closely.

Now let us examine some of the other effects (ie. job-access and job-stability as well as within-job effects) of training. For this we need data sets which are representative of all workers and we need to change our focus to outcomes such as wage rates, earnings and the receipt of high quality training from one's employer.

12. The Effect of Vocational Education on Opportunities for Further Training from Employers

The things taught in colleges and schools are not an education, but a means of education.
--Ralph Waldo Emerson, Journals, (1831)

Does occupation specific education increase or decrease one's likelihood of getting training from one's employer? One would expect schooling to be positively related to the rate at which a new hire can learn new skills. When a job is complex and requires a good deal of training, we would expect employers to attempt to reduce training costs by giving preference to applicants with additional years of schooling and school based training in the occupation. Table 11 presents data from the 1982 EOPP Employer Survey on the relationship between type and amount of schooling of a new hire and the on-the-job training typically received during the first three months on the job.[21]

The findings are that newly hired workers with more schooling and with relevant vocational training in school got more complex jobs with longer training periods and more intensive training during the first three months. Lets examine the fifth row of the table containing an overall estimate in 1982 dollars of training investment during the first three months on the job.[22] For high school graduates those with relevant vocational training got $1397 worth of training in the first three months, those without received $1027 of training. For workers with 1-3 year of college, training was $1665 for those with relevant vocational schooling and $1212 for those without relevant vocational schooling. At each level of schooling, the workers who had school-based vocational or professional training and

TABLE 11
TRAINING AND PRODUCTIVITY GROWTH OF TYPICAL NEW EMPLOYEES
by
TYPE and AMOUNT of SCHOOLING

Typical New Employees	HS Dropout		High Sch. Grad		Some College		College Grad	
	Voc Ed	No Voc Ed	Voc Ed	No Voc Ed	Voc Ed	No Voc Ed	Voc Ed	No Voc Ed
Hours Spent In Training In First 3 Months								
Watching others do the job	30.2	25.6	56.4	45.6	61.3	49.0	84	67.1
Formal training programs	4.5	5.4	17.3	7.3	19.3	15.7	10.7	8.3
Informal training by management	40.0	31.6	53.4	54.0	62.4	51.7	68.7	68.9
Informal training by co-workers	23.8	17.3	31.3	23.5	26.4	23.8	27.1	23.9
Investment in Training Time in 1981$	$664	$494	$1397	$1027	$1665	$1212	$2241	$1498
Weeks to become fully trained if no previous experience	6.5	4.2	9.7	6.3	11.1	7.3	12.4	11.3
Increase in Reported Productivity (%) (Betw. first 2 wks. & end of 2nd year)	77	45	64	67	72	79	80	93
Wage Rate								
Current wage	$ 4.20	4.26	5.68	5.16	6.19	5.35	7.65	5.37
Increase in real wage	17.1	9.2	11.3	8.7	10.6	13.6	8.9	7.9
Number of cases	46	154	284	823	134	205	47	105

Note: Tabulation of dats from the 1982 EOPP Employer Survey on the training received by typical new hires for a job. The jobs were categorized by the education level of the individual hired for that job. The sample is limited to jobs for which all the necessary questions on wage rates, training time, and productivity were answered.

obtained jobs relevant to their training obtained more complex (see row 6), better paid (row 8) jobs which offered more intensive training (row 1-5) and larger wage increases (row 9).

Clearly, graduates of vocational training programs who got jobs in their field received more training from employers than those who did not obtain vocational training. But many vocational graduates work outside the field for which they were trained (How many is discussed in Chapter 16). What happens to the average vocational graduate (when the experience of those who are unsuccessful in finding a training-related job is averaged in)? Do high school students who take vocational courses receive more subsequent employer training than students who do not take vocational courses? We can answer this question by looking at the employer training received in 1983 by youth who had graduated from high school in 1980. Forty percent said they had received formal or informal training in their current or most recent job. Multivariate regressions were estimated predicting the amount of training received in this job. The findings regarding the impact of vocational and academic course work and performance in these courses are presented in Table 12.

Table 12
Effects of Course Work and Grades on Employer Training 4 yrs after Graduation
(Estimates Based on Regression Analysis of HSB Data)

	Received Training		Hours of Training		Weeks of Training	
	Male	Female	Male	Female	Male	Female
4 Vocational Courses replace 4 Academic Courses	.063*	.076**	38	9	2.2*	.4
A or B Grades in Trade & Tech	.012	.014	33	53**	1.0	.9
A or B Grades in Bus-Office	.005	.033	-43	-2	-1.4*	-.2
GPA all Bs rather than Cs	-.032	-.012	43**	-19	.6	-.2
Math & Verbal Scores 1 SD Higher	.00	.040**	- 7	8	.2	.3
Worked 10 hrs/wk during High Sch.	.040**	.048**	12	14**	.7*	.5*
Mean for Training Variable [Standard deviation]	.39 [.24]	.41 [.24]	134 [501]	70 [253]	4.7 [14.2]	3.2 [9.4]

Source: Analysis of the second followup of the senior cohort of the High School and Beyond Data. The sample was limited to youth who had at least one full-time job since graduating from high school. Regressions included controls (not shown) for region, tenure at most recent job, years of schooling, college attendance, ethnicity, family background, scores on personality assessments taken during the senior year of high school, extracurricular activities, time spent doing homework, time spent watching TV, and many other indicators describing high school achievements. The time working variable was a mean of hours per week during junior year, senior year and during the summer between junior and senior year. Its mean (standard deviation) were 13 (10) hrs for women and 18 (10) hrs for men.

* implies significant at the 10 percent level on a 2 tail test.

** implies significant at the 5 percent level or better on a 2 tail test.

Controlling on a host of background variables, taking vocational courses in high school was associated with a significantly higher probability of receiving training and for males with extra weeks of training. Substituting four vocational courses for academic courses increasedthe incidence of training by about 16 percent. Women who received As or Bs in trade or technical courses received about 20 percent more training than women who took no such courses or got lower grades. The student's overall grade point average had inconsistent effects on the various indicators of training. High test scores had a significant positive effect on women receiving training but no statistically significant effect on the amount of training received. The student characteristic most consistently associated with the receipt of employer training 3 years after high school was having a part time job while in high school.

Thus for 1980 high school graduates indicators of academic achievement in high school have inconsistent effects on the receipt of employer training shortly after graduation. As the individual ages, however, test scores have stronger effects on the receipt of training (Veum 1994). When one looks across jobs and across individuals, we find that vocational schooling and employer training are complements not substitutes. Those who worked or received occupational training in high school tend to get jobs which offer more company training (Bishop 1991).

13. The Earnings Impact of Occupation Specific Postsecondary Education

13.1--Earnings Impacts of Sub-Baccalaureate Education--Census Data

It is well known that the payoff to college has risen dramatically in the last 15 years. The mean earnings of year-round full-time workers aged 25 to 34 with 16 years of schooling rose 19.5 (8.9) percent for females (males) between 1980 and 1989, while the mean earnings of comparable high school graduates **fell** 0.8 percent for women and **fell** 8.9 percent for men (U. S. Bureau of the Census, 1982, 1991; price index was CPI-U-X1). The gap continued to grow during the 1990s and in 1993 college graduates who were full-time full-year workers were paid 68 to 71 percent more than high school graduates.

The payoff to baccalaureate level professional education in business and technical fields has risen particularly rapidly over the last 25 years. In 1967 male college graduates

21-70 years old who had majored in business earned only 28 percent more than those who had majored in humanities. During the latter half of the 1980s, by contrast, graduates with business majors (male and female) earned 75 percent more than humanities graduates. In 1967, engineering majors earned 52 percent more than humanities majors; in the late 1980s they earned 97 percent more (U.S Bureau of the Census, 1967).[23]

The payoff to the first two years of college has also risen substantially since the late 1970s. White male full-time full-year workers 25-34 year olds with 1 to 3 years of college earned only 3.3 percent more than similar high school graduates in 1977-79. By 1987-89 the premium had risen to 13 percent. For white females the wage premium for some college rose from 10.3 percent in 1977-79 to 17.7 percent in 1987-89 (NCES 1991, p. 192-3). At the same time that relative wage rates were improving, relative unemployment rates were declining. The unemployment rates of 25-34 year olds with one to three years of college fell from 74 percent of the unemployment rate for high school graduates in 1977-79 to two-thirds of that rate in 1987-89 (NCES 1991, p. 181, 184).

The payoff to less than four years of college continued to improve in the 1990s. In 1992 the wage premium for 25 to 34 year old full-time full-year workers was 21 to 28 percent for holders of associates degrees and 14 to 15 percent for those with some college but no degree (U.S. Bureau of the Census 1993, Table 30). Seventy percent of associates degrees and 98 percent of other non-baccalaureate degrees are awarded in vocational lines of study (NCES 1993 p. 245), so these data suggest that the return to post-secondary vocational education has almost certainly increased.

Has the payoff to occupation specific training gone up as much or more than the payoff to academic lines of study at the sub-baccalaureate level? To answer this question we must analyze data sets which distinguish the type of school or training program completed. Three data sets will be examined in the pages that follow: the CPS, NLS72 and NLS Youth.

13.2--Effects of Training on Wage Rates--CPS data

Qualifying Training: Fifty-seven percent of workers reported in 1991 that they needed training to qualify for their current job. Thirty-two percent said they got 'qualifying' training from schools of some kind. Four-year colleges and universities were the source of

'qualifying' training for 18.8 percent of the work force and two year colleges were the source for 7.7 percent of the work force. Non-degree granting vocational schools were the source for only 2.7 percent of the work force and high schools the source for 3.9 percent of the work force (Eck 1993).

Table 13 presents estimates of the size of the wage payoff to qualifying training from different sources while controlling for years of schooling, potential work experience, tenure, ethnicity and gender (Bowers and Swaim (1992). The impact estimates reported represent the summed effect of first getting training from the indicated source and then using that training to get a job in the occupation trained for. Even though years of schooling is held constant in this estimation, the benefit of matching one's job to one's training is higher the greater the level and sophistication of the training. In 1991 the benefit was a:

- 2.4 percent wage increment when qualifications for one's job came from a high school training program,

Table 13

Effect of Training on Hourly Wage Levels in 1983 and 1991

	Training Needed to Get Job		Training on Current Job to Upgrade Skills	
Source of Training	1983	1991	1983	1991
Formal Company Training	.127 (10.1)	.132 (9.5)	.116 (10.1)	.144 (12.4)
Informal OJT or Exper	.108 (13.1)	.065 (7.0)	.022 (2.2)	.021 (2.0)
Military	.069 (2.6)	.079 (2.6)		
Correspondence Course	-.018 (.4)	-.050 (1.2)		
Friend	-.049 (2.1)	.037 (.5)		
Schools			.012 (.8)	-.028 (1.5)
Employer Helped Pay for Schooling			.072 (3.3)	.078 (3.2)
High School Vocational Educ	.016 (1.0)	.024 (1.2)		
Other Vocational School	.121 (6.3)	.066 (2.6)		
Two- Year College	.092 (5.5)	.130 (8.6)		
Four-Year College	.202 (16.3)	.238 (18.4)		
Received Qualifying Training			.164 (20.3)	.161 (18.6)
R Square	.447	.492	.449	.494

Source: Bowers and Swaim (1992) analysis of CPS data. All models contained controls for years of schooling, potential experience and its square, tenure and its square, and dummy variables for gender, married, husband, race, veteran, metropolitan resident, region, part-time job and union membership. T statistics are in parenthesis to the right of the coefficient.

- 13 percent wage increment when qualifying training was from a two-year college
- 24 percent wage increment when qualifying training was from a four-year college.

Returns rose between 1983 and 1991 for these types of schools.

The return to training by 'other vocational schools'--eg. beautician academies, truck driving schools and other non-collegiate generally proprietary schools--fell from 12 percent in 1983 to 6.6 percent in 1991. The return to formal company training programs remained at a very high 13 percent while the payoff to informal OJT qualifications fell to 6.5 percent.

Skill Improvement Training: Forty-one percent of workers said they had obtained skill improvement training on their current job. Most of this training was obtained at the work site. Workers who obtain such training from their current employer earn 14.4 percent extra when the training is formal and earn 2.1 percent extra when the training is informal.

Only 1.1 percent of the work force said they got skill improvement training from a non-degree post-secondary institution. Four percent said they got such training at a two-year college and 4.7 percent said they got it at a four-year college or university (Eck 1992). Fifty-six percent of skill upgrading training provided by schools received no subsidy from the worker's employer. The payoff to training that was not subsidized by the worker's employer was very low. It fell from 1.2 percent in 1983 to -2.8 percent ($t = 1.5$) in 1991. By contrast, workers who took school-based skill-improvement training that was subsidized by their employer received an 8 percent wage premium in 1983 and a 5 percent premium in 1991. Hollenbeck and Willke's (1985) analysis of the 1983 CPS data obtained similar results.

This analysis of CPS data does not, however, measure the increase in earnings caused by occupation specific training. The analysis focuses solely on the trainees who find jobs in the occupational field they prepared for. We need to also look at the vocational graduates who did not find such jobs. In addition, the study failed to control for ability and family background factors that influence labor market success. Talented individuals are more likely to obtain jobs which offer or require occupational skill training, so we may be confounding the effects of talent and training. To disentangle training effects from these other phenomena, longitudinal data on family background, ability, training and wages is needed. We turn now to studies which employ longitudinal data and effectively control for confounding effects of ability and family background.

13.3--Post-Secondary Voc-Tech Education of the Young

Studies of the effect of post-secondary vocational training using data sets which allow controls for ability, motivation and family background typically find positive effects. The effects of training are generally more positive for blacks and women than for white males. The best recent studies are by Thomas Kane and Cecilia Rouse (1993, 1995). Controlling on test scores and grades in high school, family SES, other demographic characteristics and actual work experience, Kane and Rouse's found that earnings of 32 year olds rose 6 percent per year (30 semester credits) of attendance at a two year college even when no degree was attained. A two year associates degree raised earnings by 8 (29) percent for males (females) in NLS-Class of 72 data and by 27 (36) percent for males and females in NLS-Youth data. While the sample is not large enough to make the differences statistically significant, point estimates suggest that private 2 year colleges had larger earnings effects than public colleges and that vocational-technical schools had smaller effects (1995 Grubb 1995). Analysis of NLS-72 and SIPP data has also found that associates degrees and credits in scientific, technical and vocational fields increase earnings more than degrees and credits in academic subjects (Kane and Rouse 1995, Grubb 1994, 1995). For women, an important part of the effect of sub-baccalaureate schooling is the aid it provides in finding steady work. When work experience was not controlled, vocational school certificates and associates degrees in vocational fields from community colleges both added about $2800. to earnings. An academic associates degree added about $2260. to earnings.

13.4--Impacts of Occupational Training on Wage Growth of Adults

When it comes to evaluating the impacts of training obtained by adults, controlling for test scores and family background is not likely be sufficient. Talent varies a great deal among adults even when test scores, parent's background and years of schooling are held constant. Those with the greatest talent are more likely to obtain the more complex higher paid jobs that involve continuous training, so associations between wage rates and training may reflect their common relationship with talent or past job performance.

The causal effects of training received by adults, thus, need to be assessed by examining its impacts on changes in wage rates. This method uses the prior (to training) accomplishments (wages) of the worker to control for elements of talent and ability that are

otherwise not directly measurable. In effect, the wage gains of workers who receive training during a time interval are compared to the wage gains of those who do not receive training.

Lynch's (1992) study of the wage growth experienced by NLSY youth in their late teens and early 20s found that, controlling for job changes and changes in unionization, tenure and experience, that wage rates were increased 12 percent by apprenticeship training and increased 6 percent by off-the-job-training (mostly obtained at schools), but were unaffected by formal company training programs lasting 4 weeks or more.

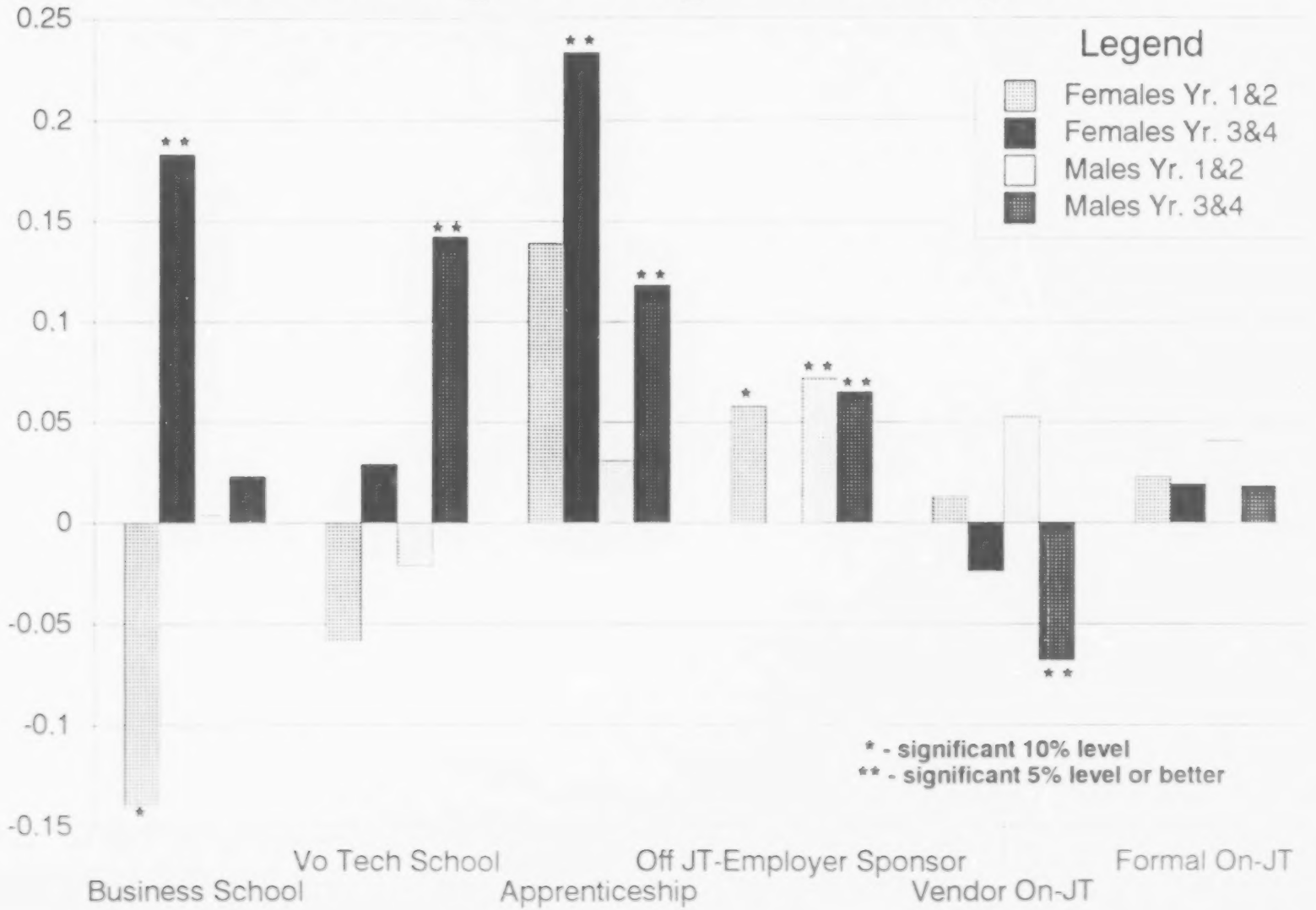
Studies of workers with a few more years of work experience tend to find that company training has bigger effects. Blanchflower and Lynch's (1994) study of wage growth of non-college graduates from age 20 to 25 found company training raised wages by 12 percent ($t = 1.94$), off-job training (provided generally by a school) raised wages by 5 percent ($t = 1.02$) and apprenticeships raised wages by 38 percent ($t = 3.38$).

Veum's (1994) study of 1986-90 wage growth found that the receipt of company training had large effects on wage growth, but having a large rather than a small amount of training did not. The 18 percent who received company training during the four years obtained 9 percent larger wage increases ($t = 2.3$).

Lowenstein and Spletzer's (1994, Table 3) study of newly hired workers in the NLSY found that a completed spell of company training during the previous year raised wage growth during that one year period by 3.6 percent ($t = 1.79$). Off-job training financed entirely by the worker did not have an effect on wage rates in the one year time frame. Off-job training subsidized by the worker's employer did raise wage rates the next year--particularly when the worker switched employers. A limitation of the Lowenstein-Spletzer study is its exclusive focus on only the immediate response of wage rates to training.

Paul Lengermann's (1994) analysis of NLSY data examined wage growth during a four year period from 1988 to 1992, so it does not have this limitation. Controlling for school attendance, current participation in training, tenure, job changes and a host of other variables, Lengermann found that training from business colleges, Voc-Tech colleges and apprenticeships had delayed impacts on the worker's wage rate. Figure 8 presents these results. Lighter bars represent the effects of training received in the latter half of the four year period for which wage growth is calculated. School provided training obtained during fiscal 1991 and 1992 had no effects on wage growth from 1988 to 1992 for men and

FIGURE 8
The Timing of Wage Rate Impacts



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significant negative effects on wage growth for women. The darker bars, by contrast, represent the effects of training received during the first half of the four year period.

Business college training obtained in fiscal 1989 or fiscal 1990 raised 1988 to 1992 wage growth of women by 18 percent (t=2.97) but had no significant effect on the wage growth of the small group of men who attended these institutions. Vocational-technical college attendance in fiscal 1989 or fiscal 1990 raised 1988 to 1992 wage growth by 17 percent (t=2.91) for men and 5.4 percent (t=0.95) for women. Apprenticeship training in the first half of the time period also had larger positive impacts on training than apprenticeship training undertaken during the latter half of the four year period.

Now let us examine company sponsored training. Three different types can be distinguished: seminars outside of work (Employer sponsored Off-JT), formal training provided at work but delivered by outside vendors (Vendor On-JT, and formal training delivered by company staff at the work site (Formal On-JT). Being sent to seminars outside of work (generally for 50 to 80 hours on average) raised wage rates by a statistically significant 6 to 7 percent. The wage increase appears to have persisted for men but not for women.

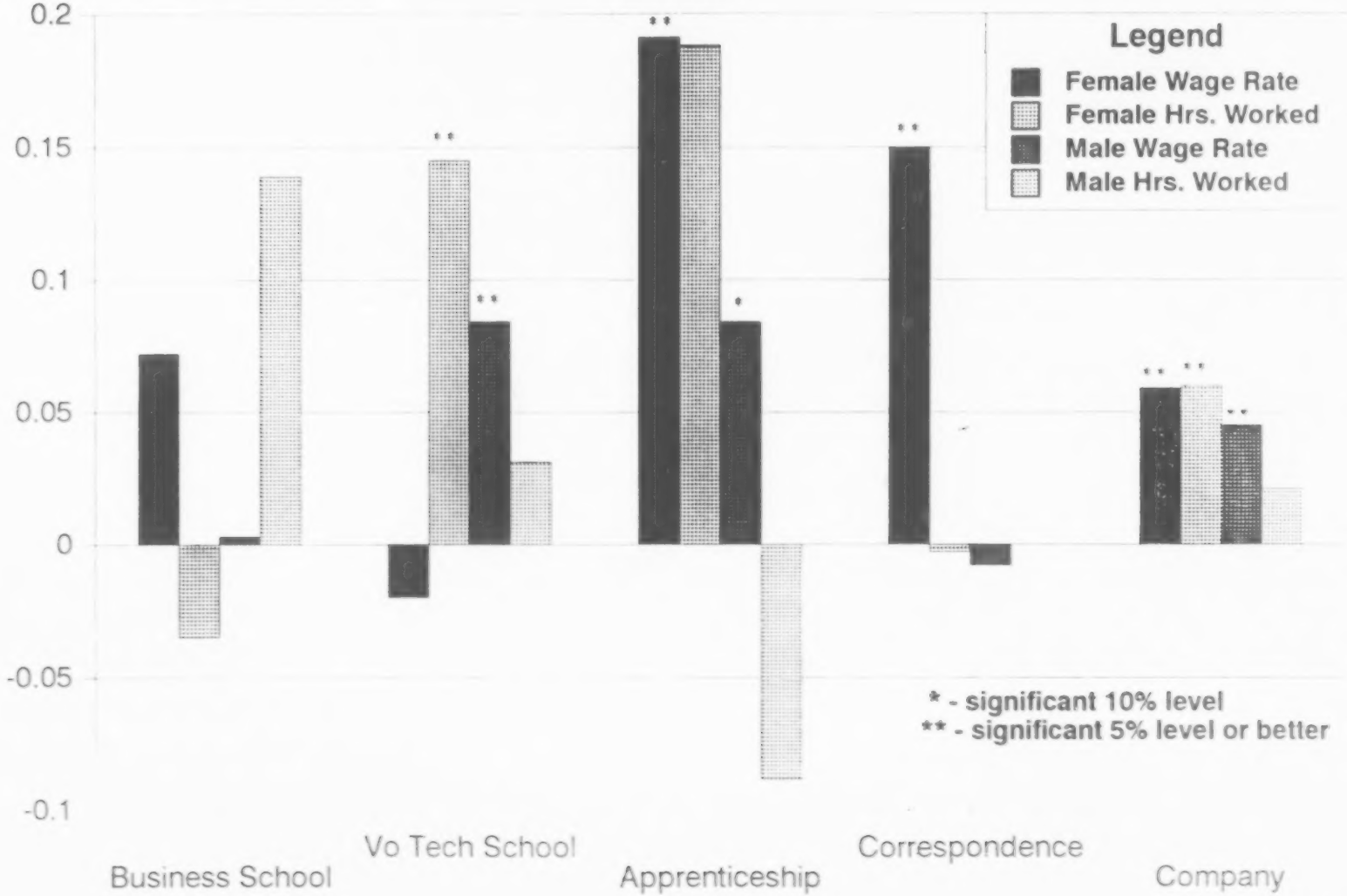
For those who receive it, formal training by in-house staff averages 221 hours for men and 152 hours for females. It had small positive effects on wage growth, but the effects were not statistically significant. Vendor provided training had inconsistent effects on wage growth. The results for the three types of company training suggest that depreciation rates may be substantial. Employer sponsored training received during the first half of the time period had smaller effects (in one case negative effects) on four year wage growth. Apparently, employer sponsored training that involves leaving the work-site for classes (often located at a school) has bigger effects on wage rates than other types of employer training.

Lengermann also analyzed the impact of training during fiscal years 1989, 1990 and 1991 on the growth in hours worked from fiscal 1988 to fiscal 1992. Figure 9 presents both these results and estimates of the impact of training during fiscal years 1989-1992 on wage growth from 1998 to 1992. The darker bars represent the percentage increases in wage rates associated with a particular type of training. The lighter bars represent the percentage changes in annual hours worked that are associated with the receipt of each type of training.

FIGURE 9

Training's Impact on Wage Rates & Hours Worked

by Type



Apprenticeships had large statistically significant effects on wage rates. Though not significantly different from zero, the point estimates suggest that apprenticeships had large positive effects on hours worked by women, but negative effects on hours worked by men. The apprentices in the sample devoted about 500 hours to their apprenticeship training during the four year interval, so payback appears to have been achieved within a year for women.

Company training had significant effects on the wage rates of both men and women and significant effects on hours worked by women. When the two effects are combined, the earnings impact is 12 percent for women and 6.6 percent for men. For those getting it, company training averages only 125 hours for women and 203 hours for men. Therefore, payback is achieved in less than a year for women and less than 3 years for men.

Training clearly has positive effects on hours worked as well as wage rates. Indeed for women attending voc-tech schools and men attending business colleges, increases in hours appear to be the sole short run benefit. The time costs of this training is quite modest. Those who take training at business college and voc-tech colleges typically devote an average of 455 hours to their studies--less than one quarter of a year during the four year period of measurement. The sum of the wage plus hours impacts of this school-based training is generally above ten percent, so our point estimates imply payback is achieved within 3 or 4 years.

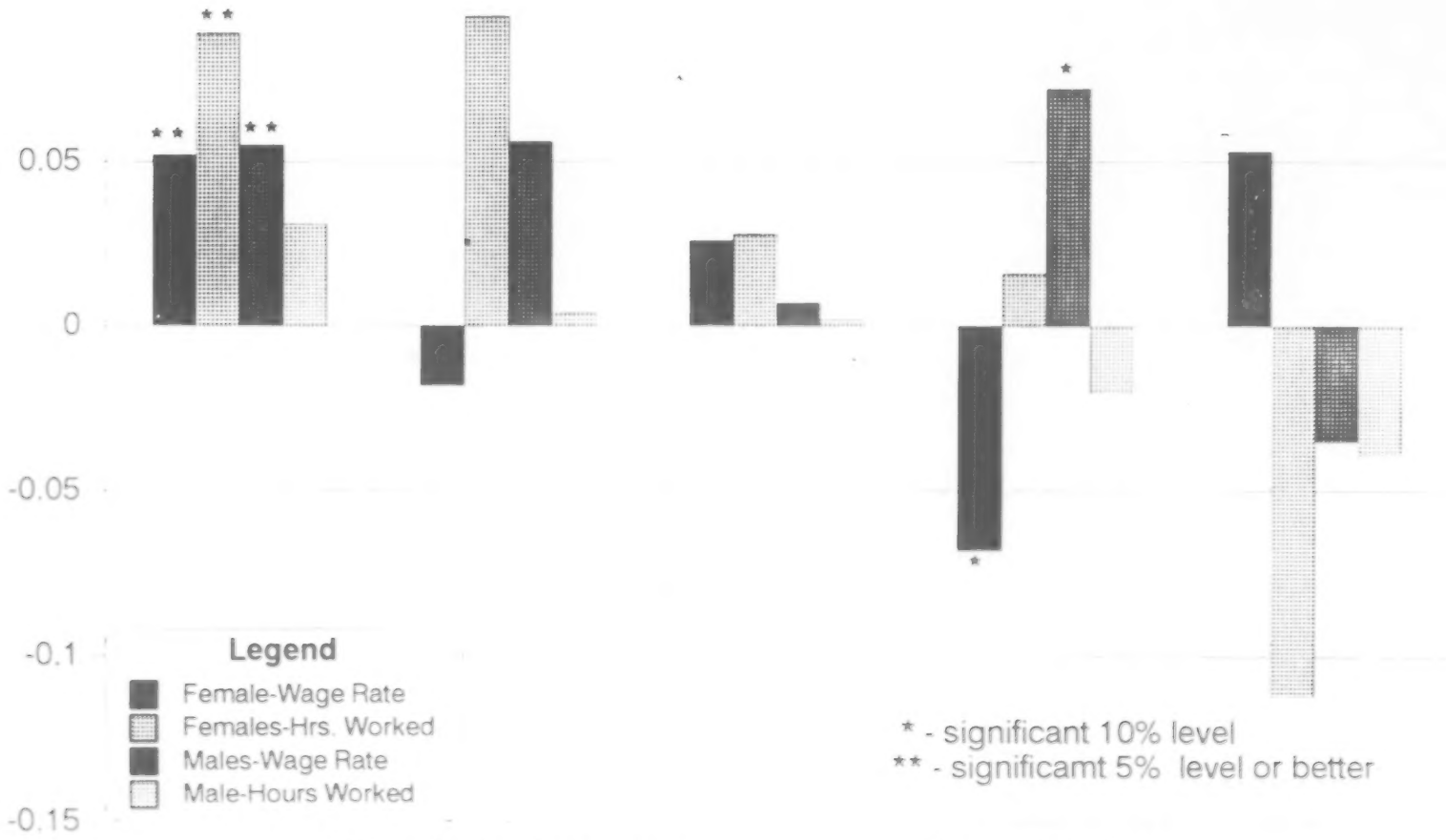
Lengermann also analyzed the effect of training format (teaching method) on growth of wage rates and hours. His results are presented in Figure 10. The two primary formats were job skill training delivered in classrooms and on-the-job training. Twenty-two percent of workers received classroom job skills training. Slightly more than 10 percent received on-the-job training. Classroom training had significant positive effects on wage rates and hours worked, while on-the-job training did not. The point estimates also suggest that basic skills education delivered in classrooms also had positive effects on the hours worked of women and the wage rates of men. The much maligned technique of chalk and talk does not appear to be out classed by more active learning approaches such as on-the-job training and other.

Two-thirds of the school based training was subsidized by employers. Consistent with Lowenstein and Spletzer's findings, wage increases were smaller when the individual paid

Figure 10

Impact of Training on Wages & Hours Worked

by Format



all the costs of the training (not shown in figure). Three of four coefficients on a dummy for self-sponsorship were negative, one significantly so. An interesting finding of some of these wage growth studies is that, at least in the short run, training has a larger wage payoff when an employer sponsors or subsidizes it than when the worker selects it and pays for it. This suggests that employers may be better at picking effective school based training programs than individual workers.[24]

13.5--Military Training

Military training also appears to have substantial positive effects on the wages and productivity of those exiting the armed forces. Mangum and Ball (1986) estimate that about 48 percent of those trained by the military get civilian jobs in that same field. The results reported in Figure 6 indicate that, when the training is relevant to the job obtained, workers trained in the military were 10 percent more productive than other employees after about a year on the job and are more likely to make suggestions that are adopted. Their success on the job appears to surprise their employer and, consequently, they are not paid the higher wage rates their high productivity would seem to justify.

13.6--Job Training Partnership Act Training

The best evidence on the wage impacts of government training programs for the disadvantaged comes from studies employing strong randomized designs. The latest findings from the Abt Associates evaluation of the Job Training Partnership Act are presented in Table 14. The per enrollee costs of JTPA classroom training are $1457 for adults and $1863 for youth. For classroom training the earnings gains (during the 30 months followup period) were $630 for adult women and $1287 for adult men. If the earnings differential between experimentals and controls for the final year of the study continues into the 4th and 5th years after enrollment in JTPA, the costs of the services are recouped in higher earnings within five years for adult women and within 3 years for adult men. On-the-job training had larger effects than classroom training on the earnings of adults. Payback periods were 18 months for adult women and 22 months for adult men. The other services treatment stream--mainly basic education, JSA, job readiness training, vocational exploration and tryout employment--was the least costly of all. Adult women who received these services

Table 14
Job Training Partnership Act Training: Impacts per Enrollee

	Incremental Cost		Earnings Increase for Months 1 to 30				
	Adults	Youth	Adult Women	Adult Men	Young Women	Young Male Non-arrestees	Young Male Arrestees[1]
Classroom Training	$1,457	$1,863	$ 630 (5.5%)	$1,287 (7.1%)	$ 839 (8.9%)	$ 251 (1.6%)	- 6,804 (-36.0%)
On-Job-Training/ Job Search Assist	$1,330	$2,908	$2,292 (15.3%)	$2,109 (9.8%)	-$ 578 (- 3.9%)	-$3,012 (-12.6%)	- 6,804 (-36.0%)
Other Services	$ 601	$ 359	$3,949 (38.6%)	$ 941 (4.9%)	-$ 33 (-0.4%)	-$ 438 (- 3.3%)	- 6,804 (-36.0%)

Source: Howard Bloom et al. The National JTPA Study-Overview, Washington D.C.: Abt Associates, Jan. 1994, Exhibits 5, 12, 13, 14 & 15. The effects of enrollment in JTPA were calculated by dividing the effects per assignee by the proportion of assignees who enrolled in at least one kind of JTPA training. Many assignees participated in more than one form of training. Job Search Assistance (JSA) was often a part of the package of services given. For adults the proportion of enrollees that received JSA was 20 percent for classroom training, 51 percent for on-the-job training and 40 percent for other services. For youth the proportion of enrollees getting JSA was 41 percent for classroom training, 52 percent for on-the-job training and 18 percent for other services. Forty-three percent of youth enrollees in other services received basic education.

1. Estimated earnings impacts are based on survey data as are all other numbers in the table. In UI wage record data, JTPA had no impact on the earnings of this group. The truth probably lies in between zero and the -$6,804 from the survey. The sample of young male arrestees was too small to distinguish different types of services, so an average for all service streams is reported.

earned 39 percent more than their control group. Since costs were only $601 per enrollee payback was achieved in 7 months for adult women and 19 months for adult men.

Disadvantaged youth (under age 22), however, do not appear to be helped by JTPA services. For example, young men with arrest records prior to entering JTPA earned $6800 less during the 30 month followup period than similar young men denied JTPA services. Young men without an arrest record who were enrolled in the on-the-job training stream earned $3012 less during the 30 month followup period than those who were denied JTPA services. Those assigned to the other services treatment--mainly basic education, JSA, job readiness training, vocational exploration and tryout employment--also earned less than the control group. For young women, classroom training appears to have raised earnings somewhat, but the payback period is 5 years (Bloom, Orr, Cave, Bell and Doolittle, 1992). Evaluations of Job Start came to similar conclusions (Cave, Bos, Doolittle and Toussaint,

1993). Of the various programs designed to serve disadvantaged youth, only the Job Corps, a considerably more costly program, appears to have significant positive impacts (Maller, Kerachsky and Thornton 1982).

One possible explanation of the negative impacts of JTPA on youth earnings is stigma. Studies have found that the subsidies for hiring the disadvantaged such as the Targeted Jobs Tax Credit stigmatize job applicants who are revealed to be members of the target group (Burtless 1985) and that, consequently, they are paid less than other new hires for the same job even though they typically produce more (Bishop 1989b). Since JTPA training is given only to disadvantaged individuals, advertizing oneself as a JTPA trainee may hurt the individual's marketability and wage rates even when the training substantially raises the productivity.

The findings presented in Figure 6 suggests this may be happening in the JTPA program. Analysis of the NFIB survey indicates that **new hires who were known to have received JTPA training were 14 percent more productive** [after 6 months (P=.098) and at the time of the interview (P=.187)] than other new hires and had lower rates of turnover. Nevertheless, the JTPA trainees were paid 7 percent less than other workers hired for that job (P=.33) (Bishop 1994). In this data set, JTPA trained workers were simultaneously more productive and less well paid. These findings suggest that conventional evaluations of CETA and JTPA which measure wage and earnings effects will often falsely signal the programs are not cost effective. Even when they fail to raise the wage rates of the target group, the program may be having substantial positive effects on the productivity of the trainees. The stigma is a consequence of signalling the trainee's disadvantaged status, so an obvious implication of these findings is that JTPA trainees should be trained in main stream institutions and marketed to employers without revealing that their training was funded by JTPA.

14. Trends in the Effect of High School Vocational Education on Wages

14.1--The Payoff during the 1970s

There have been quite a few American studies of the impact of high school vocational education on labor market success of non-college bound youth. Most of the

studies analyzing data collected during the 1970s used student reports of their track to define participation in vocational education (Grasso and Shea 1981, Gustman and Steinmeier 1981, Woods and Haney 1981). When, however, these student reports of track were cross checked against transcripts, it was found that some of the self-identified vocational students had only a few vocational courses on their transcript and many "general track" students had taken 3 or 4 vocational courses (Campbell, Orth and Seitz 1981). Since it is the number and types of courses taken which are influenced by school policy, studies of the impact of vocational education need to employ objective measures of participation and not self-assessments of track, which apparently measure the student's state of mind as much as they measure the courses actually taken.

The solution to this problem is to use transcripts or reports of actual courses taken to measure participation in vocational education. In his analysis of longitudinal data on approximately 3500 men and women who graduated from high school in 1972, Meyer (1981) used school reports of the number of courses taken in vocational and nonvocational fields to define a continuous variable: the share of courses that were vocational. He found that females who devoted one-third of their high school course work to clerical training earned 16 percent more during the seven years following graduation than those who took no vocational courses (see Table 15). Those who specialized in home economics or other non-clerical vocational courses did not obtain higher earnings. Males who specialized in trade and industry earned 2.8 percent more than those in the general curriculum. Males in commercial or technical programs did not earn significantly more than those who pursued a general curriculum.

Rumberger and Daymont (1982) used transcripts to define variables for the share of course work during the 10th, 11th and 12th grades that was vocational and the share that was neither academic nor vocational. Analyzing 1979/80 data on 1161 young adults in the National Longitudinal Survey (NLS) who were not attending college full time and had attended high school during the early and middle 1970s, they found that males who devoted one-third of their time to vocational studies instead of pursuing a predominantly academic curriculum spent about 12 percent more hours in employment, but experienced slightly greater unemployment and received a 3 percent lower wage. Females who similarly devoted one-third of their time to vocational studies at the expense of academic course work were

Table 15

THE EFFECT OF OCCUPATIONAL TRAINING ON YEARLY EARNINGS
A Comparison of Studies

High School Vocational Education

Post 1983 Studies

Kang/Bishop (1986)	1981
Women: Business	$1674 (40%)
Trade & Tech.	$ 262 (6%)
Other	$ 882 (22%)
Men: Business	$-192 (-3%)
Trade & Tech.	$1472 (21%)
Other	$2488 (36%)

Campbell et al (1986)	
NLS-1983	$ 933 (17%)
HSB-1983	--- (27%)

Pre-1983 Studies

Meyer (1982)	Avg 73-79	1973
Women: Business	$ 410 (16%)	$ 426
Tech.	$ -72 (-2%)	$ -37
Home Econ.	$-248 (-5%)	$ 118
Men: Business	$ 106 (1%)	$ 86
Trade & Ind.	$ 201 (3%)	$ 493
Other Tech.	$ 94 (1%)	$ 491

Rumberger/Daymont (1982)	1979
Women	--- (8%)
Men	--- (10%)

Occupational Training of Disadvantaged Youth

Comparison Group Methodology

CETA--(Bassi et al	
Young Women	$-302
Young Men	$-874
CETA--(Dickinson et al.	
Young Women	$ 117
Young Men	$-565

Job Corps--(Maller et al. 1982)	
First Year	$ 515
Second Year	$ 667
Third Year	$ 652
Fourth Year	$ 787

Control Group Methodology

Supported Work--(Fraker/Maynard)	
Disadv. Youth	$ -18
Women on Welfare	$ 351

JTPA-Classroom Occ Training (Bloom et al 1992)	
First 6 months	$-301
Next Year	$ -99

The Kang/Bishop estimates are based on the quadratic model and assume the individual goes from zero to 4 vocational courses and reduces academic courses from 12 to 8, with the reduction occurring in the following subjects: math, foreign language, science, and social science. The other category of vocational courses in Kang/Bishop includes home economics and exploratory vocational courses. Campbell et al. (1986, 1987) results are a weighted average for all three patterns of participation that combine those who found training related jobs with those who did not. Meyer (1982) and Rumberger/Daymont (1982) results are calculated by multiplying the coefficient on the proportion of courses that is vocational by .33. The CETA estimates are taken from Barnow's (1987, Table 3) review of the literature and are a simple average of results for white and minority youth. The Job Corps estimate includes both civilian and military jobs and uses non-linear time trends (Maller et al. 1982 p. ix). The Supported Work result is from Table 5 of Fraker/Maynard (1987). The JTPA results are from Bloom et al (1992). The estimated effects are reported in current dollars. The dates reported are the year of the earnings data. Since the studies analyze data from different years, comparisons between studies may be influenced by differences in the general level of wages.

paid the same wage but spent about 8 percent more time in employment and 1.6 percent less time unemployed.

14.2 The Payoff during the 1980s

Studies of vocational education that have used more recent data sets have obtained much more positive results. Kang and Bishop's (1986) study of 2485 men and women who graduated from high school in 1980 and did not attend college full-time used student reports [transcripts were not available] of courses taken in three different vocational areas--business and sales, trade and technical, and other--and five academic subjects--English, math, science, social science and foreign languages--as measures of curriculum. Males who took 4 courses (about 22 percent of their time during the final three years of high school) in trade and technical or other vocational subjects by cutting back on academic courses were paid a 7 to 8 percent higher wage, worked 10 to 12 percent more, and earned 21 to 35 percent more during 1981, the first calendar year following graduation. Males who took commercial courses did not have higher earnings or wage rates. Females who substituted 4 courses in office or distributive education for 4 academic courses were paid an 8 percent higher wage, worked 18 percent more, and earned 40 percent more during 1981. Females who took trade and technical courses did not receive higher wage rates and earned 6 percent more than those who pursued an academic curriculum. The benefits probably diminish in later years, but this is of little consequence since the incremental costs of four vocational courses can be recovered in just one or two years at this rate.

Joseph Altonji's (1988) study of the NLS Class of 72 followup surveys for 1973 through 1986 found modest positive effects of vocational course work on hourly wage rates. Holding years of further education constant, four trade and technical courses substituted for a mix of academic courses (English, foreign language, social studies, science and mathematics) raised wage rates by 5 to 10.3 percent depending on specification. Substituting four commercial courses for a mix of academic courses had no effect on wages in OLS models but raised wage rates by 3 percent in instrumental variable models intended to correct for selection bias.

Recent studies of students who graduated in the late 1970s and early 1980s by Paul Campbell and his colleagues at the National Center for Research on Vocational Education

also obtained positive findings. Controlling for test scores and past and present enrollment in higher education, their analysis of 1983 and 1985 National Longitudinal Survey data on 6953 young men and women between the ages of 19 and 28 found that graduates of vocational programs had 16.5 percent higher earnings than those who had specialized in academic courses [comparison is made with academic rather than general track students because most general track students take one or two vocational courses]. A parallel analysis of High School and Beyond data on 6098 students who graduated in 1982 (which also controlled for test scores and college attendance) found that the vocational graduates were 14.9 percent more likely to be in the labor force in 1983/84, were one percentage point less likely to be unemployed, and were paid about 9 percent more per month than the academic graduates. The overall earnings effect was 27 percent. The differential between vocational and general curriculum graduates [who generally took 1 to 2 vocational courses] was generally about half the size of the differential between vocational and academic graduates (Campbell et. al., 1986, 1987).

These positive results contrast markedly with the negative findings regarding classroom occupational skills training programs targeted on disadvantaged youth such as the Job Training Partnership Act (JTPA), the Comprehensive Employment and Training Act (CETA) and the Supported Work Demonstration (see the right hand side of Table 10). For example, youth under 22 years of age who applied for and were offered JTPA classroom occupational skills training earned **$501. less** during the 30 months following assignment than a randomly assigned control group (Bloom, Orr, Cave, Bell, Doolittle and Lin 1994). Only the Job Corps, a considerably more costly training program, appears to have positive impacts that even approach these in magnitude.

14.3--Why did the Payoff Increase?

There are three reasons for viewing the more recent studies of vocational training in U.S. secondary schools as more accurate descriptions of current impacts than the studies published prior to 1983. First, large samples are preferable to small samples. In the four year interval between the Rumberger/Daymont analysis of NLS youth data and Campbell et al's analysis, the number of graduates for which high school transcript data was available nearly doubled. This makes the findings in Campbell et al's 1986 and 1987 papers a more

reliable estimate of vocational education's effect than those provided by Rumberger and Daymont's 1982 study and the early studies of NLS data done by Mertens and Gardner (1982) and others.

Second, vocational education has been changing rapidly. During the 1970s, competency based instruction tied to competency profiles certifying the skills learned became common practice, career education courses preceding the selection of an occupational specialty were introduced, job search skills were added to the curriculum of most vocational programs, home economics was reoriented from a focus on home making to a focus on preparation for work, and the content of many individual programs was upgraded and updated. Consequently, the data on the younger members of the NLS Youth sample and on High School and Beyond students, who received their vocational instruction between 1978 and 1982, is more relevant to vocational education as it is now practiced than the Class of 1972 data analyzed by Meyer, Gustman/Steinmeier and Woods/Haney.

Finally, as already discussed, the rewards for the skills taught in school are growing. During the 1980s high school graduates with vocational training suffered a decline in their real wage during this period, but those without any vocational training suffered even bigger declines. While vocational students who do not go to college do better in the labor market than the academic or general students who do not go to college, those who enter college and complete a degree do even better. Consequently, everyone who is capable of handling college should be encouraged to go. However, for high school students not planning to attend college or uncertain about attending college long enough to complete a certificate or degree, vocational studies would appear to be highly recommended. The programs 22 should be structured so as not to foreclose the student's changing their mind about college.

Whoever acquires knowledge and does not practice it
resembles him who ploughs his land and leaves it unsown.
--Sa'Di, Gulistan, 8.42, tr James Ross (1258)

Knowledge may give weight, but accomplishments give lustre,
and many more see than weigh.
--Lord Chesterton, Letters, May 8 1750.

PART V
POLICY IMPLICATIONS

15. Do the Benefits of Vocational Education Depend on Getting a Training Related Job ?

15.1--Effects on Earnings

Two of the studies discussed in section 13 (Campbell, et al. 1986; Rumberger and Daymont 1982) have examined whether the economic benefits of vocational education depend on finding a training related job. Both studies found that getting a training related job was essential for the training to payoff. Table 15 summarizes Campbell, et al.'s analysis of data on males and females combined from the High School and Beyond and the National Longitudinal Survey. Vocational graduates who obtain a job in an occupation matching their field of training spend about 20 percent more time in the labor force than general track graduates.[25] Their rates of unemployment are about 3 percentage points lower. Vocational graduates working outside their field of training are not significantly more likely to be in the labor force or to be employed than general track graduates.

The third and fourth columns of the table present estimates of the effect of vocational education on current monthly earnings controlling for current and past enrollment in college. High school graduates who took a vocational concentration obtain significantly higher monthly earnings (7 to 8 percent higher) only when their current job is related to their training. When their current job is not related to their training, they do not receive higher wage rates than students who have pursued a general program of study in high school. Students who pursued an academic curriculum in high school did not do better than those pursuing a general curriculum; in one data set they were earning 5% less.

Table 16

THE ECONOMIC EFFECT OF VOCATIONAL EDUCATION

(Relative to Graduates Who Pursued a General Curriculum)

OUTCOMES

Groups In Comparison to General Curriculum	Labor Force Participation (age 20)	Unemployment (age 20)	Monthly Earnings (age 20)	Monthly Earnings (age 19-26)
Vocational Grads				1985
Training Related	20%***	-3*	7%**	8%**
Not Training Related	2%	1	3%*	-5%
Academic Grads	-9%***	1	-5%*	0%

Source: Table 14 and 16 of Campbell, Basinger, Dauner, and Parks, Outcomes of Vocational Education for Minorities, the Handicapped and the Poor. The classification of students into vocational, academic and general was based on the high school transcript. A graduate was in a training related job when the occupation matched (liberally defined) the field for which he/she trained. Results reported are averages of coefficients on concentrator, limited concentrator and concentrator explorer. For the labor force participation model the value presented in the table are the estimated coefficients divided by the mean labor force participation rate. Coefficients from regressions predicting the log of monthly earnings have been multiplied by 100 to approximate percentage impacts. The regressions included controls for the following: sex, minority status, handicapped, limited English proficient, test scores, grade point average, family background, attitudes, past and present college attendance, employment during high school, aspirations in 8th grade, region, rural/urban. The fourth column reports analyses of NLS data. Taken from Table 7 of Campbell et al., 1988b. The first 3 columns are based on HSB data and contain additional controls for presence of a spouse or child, absenteeism and discipline problems in high school. The monthly earnings models control for labor market experience and tenure on ones current job. The HBS model of monthly earnings also contained controls for occupation. The average significance level of the coefficients are indicated by the number of stars. *** is significant at the .01 level using a two tail test. ** is significant at the .05 level. * is significant at the .10 level.

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If students stay in the occupation for which they train for many years, the benefits of the occupational training appear to grow even larger. An analysis of data from the NLS reported in Campbell et al (1987) found that graduates of vocational programs who spent 100% of their work time since high school in a training related job earned 31 percent more in 1984 than the vocational graduates who had never had a training related job.

15.2--Effects on Productivity and Training Costs

Studies of the effect of vocational education on the productivity of new hires have found that vocationally trained workers are somewhat more productive and less costly to train than other workers doing the same job but only when the job is related to their training. The evidence for this statement comes from statistical comparisons of pairs of workers doing the same job.[26] The data are presented in table 16, which has been summarized from Bishop (1982, 1985). Compared to those without vocational training, new

Table 17
Productivity Consequences of Relevant vs Irrelevant Training

Outcomes	Relevant High School Training	Relevant Public PostSecondary Training	Non-Relevant Training
Required Training Time	-9%	-22%**	6.3%
Productivity: First 2 Weeks	3%	13%**	-6.0%
Next 10 Weeks	2%	4%	-0.5%
Current or most recent	3%	1%	1.4%

Source: Impact estimates are relative to someone without vocational training. The estimates for relevant training in columns 1 and 2 are from Table 3.13 of Bishop et al, 1985. The estimates of the impact of non-relevant training are from Table 5 of Bishop 1982. ** implies significant at the 5 percent level on a two tail test.

hires with relevant training in high school required 9 percent less training, and were 3 percent more productive both initially and after a year or so on the job. Not surprisingly, those with relevant training from postsecondary institutions did even better. If, however, the training is not relevant to the job, graduates of secondary and postsecondary vocational programs were initially less productive, required 6 percent more training during the first 3 months on the job, and were only slightly (1.4 percent) more productive after a year at the firm.

These findings imply that the private and social benefits of vocational education derive from the occupationally specific skills that are developed. Some of the skills taught in vocational classes are transferable--useful in a great variety of occupations--but skills taught in nonvocational classes are transferable as well. Vocational classes are not better at instilling valuable transferable skills than nonvocational classes. In other words, vocational education as now practiced does not do a better job of preparing youth for generic jobs than more academic forms of education. There may be ways of delivering vocational education that do a better job of teaching character or generic skills than an academic education, but these programs are not common enough to affect statistics on the aggregate impact of vocational education.

16. To What Extent are the Occupationally Specific Skills Learned in High School Being Used?

How frequently do the students who pursue a vocational specialty in high school use their training in their job and therefore benefit from their occupationally specific training? The empirical work reported in the previous section classified a youth as having a training related job when the occupation of the individual's current or most recent job matched his/her field of training. By this definition, 43 percent of the employed graduates who completed two or more vocational courses in a specific field had a training related job (broadly defined) in 1985 (Campbell et al., 1987).[27] Other studies of high school vocational education using a similar methodology obtain similar results. Felstehausen's (1973) study of 1981 vocational graduates in Illinois found training related placement rates of 27 percent in business occupations, 17 percent in trade and industry, 52 percent in health, and 20 percent in agriculture. Conroy and Diamond's study (1976) of Massachusetts graduates obtained a training related placement rate of 29 percent for business and 37 percent for trades and industry.

High school vocational education, however, is not the only occupational training program with low training related placement rates. The proportion of CETA participants whose occupational field 12 months after completion of training matched their field of

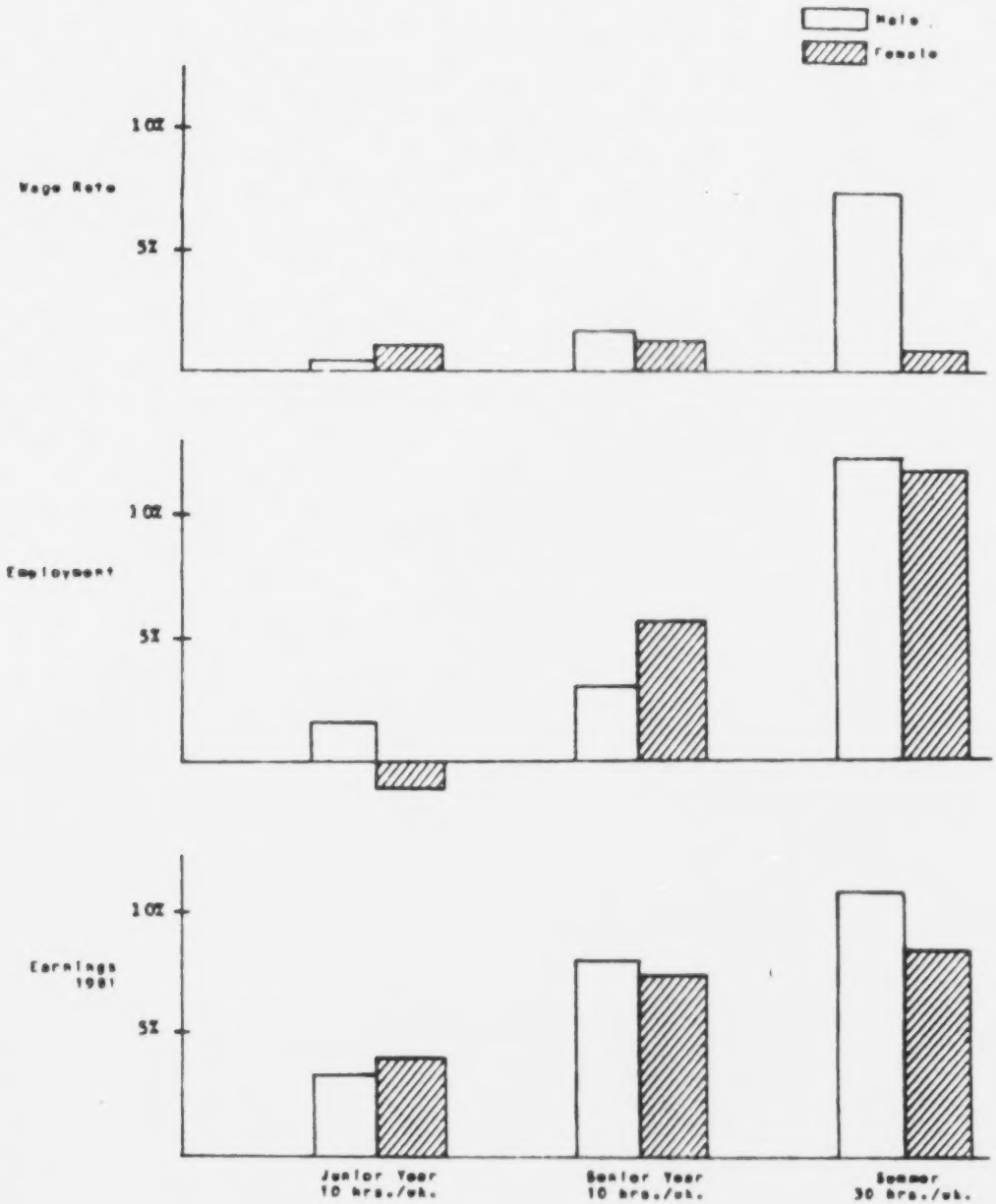


Figure 13. Effects of work during high school on post high school labor market success.

training was only 41 percent for clerical training, 39 percent for training in operative occupations and 32 to 29 percent for craft and professional training (Barnow 1985).

When a less rigorous definition of training relatedness is used (e.g. one based on questions like "On your present job, how much do you use the vocational training you received in high school or area vocational center?" Bice and Brown, 1973), more than half of vocational graduates report using their training. This implies that a substantial minority of vocational graduates report making some use of their vocational education even though there is no match between their occupation and their training.[28]

College graduates also frequently take jobs that are unrelated to their major. One year after graduating, __ percent of 1990 graduates said their jobs were 'closely related' and ___ percent said their jobs were 'somewhat related' to their major. Over 85 percent of engineering, health professions, education, and math and physical science majors reported getting jobs that were either closely or somewhat related to their major. Only 57 percent of humanities majors, 53 percent of social science majors and 30 percent of history majors obtained jobs closely or somewhat related to their major (National Center for Education Statistics 1993 p. 17).

17. Why Are Many Graduates of Training Programs Not Employed in the Occupation for Which They Prepared?

In 1980, the National Center for Research in Vocational Education undertook a massive study of the determinants of training related placement rates (McKinney et al., 1982; Lewis et al., 1982). Controlling for the local unemployment rate and the congruence of school and community racial composition, Lewis et al. (1982) found that training related placement rates were higher when vocational teachers accepted responsibility for placement, when they spent considerable time on placement, when admission to the program was restricted, and when career exploration was an important part of the program.

Other research suggests that another important cause of the problem is the limited employer involvement in the training. Mangum and Ball (1986) have found in their analyses of NLS data that employer controlled training institutions have higher training related placement rates. Using a procedure of matching training fields against jobs, they found that

the proportion of male graduates who had at least one job in a related field was 85 percent for company training, 71 percent for apprenticeship, 52 percent for vocational-technical institutes, 22 percent for proprietary business colleges, and 47 percent for military trainees who completed their tour of duty. The rates for females were 82 percent for company training, 59 percent for nursing schools, 61 percent for vocational-technical institutes, 55 percent for proprietary business colleges, and 49 percent for military training. German apprenticeship training is also highly likely to lead to relevant jobs. Six months after completing their training, 68 percent of those with civilian jobs were employed in the occupation for which they were trained (much more narrowly defined) (Federal Institute for Vocational Training, 1986).[29]

The graduates who do not find training related jobs often complained that no such jobs were available. Aggregating the data from 3 different follow-up studies, Mertens et al. (1980) report that 25 percent said no job was available in an area related to training, 11 percent said their high school training was insufficient, and 10 percent said they couldn't earn enough money in a related field. These statistics suggest that occupational training needs to be sensitive to the market both in the selection of and design of training programs.

Poor career guidance is apparently contributing to the problem for the 21 percent who said they left the field because they didn't like the work, for the 2 percent who said they didn't know what the job was really like and for the 5 percent who said they switched fields when they got training in the military or at a postsecondary institution.

Some of the students apparently take occupational courses have no real plans to pursue a related occupation. Some counselors report that some of the students take vocational courses to avoid more difficult academic subjects or to get permission to take a job during part of the school day.

More commonly they are unsure about what field or occupation they want to pursue. Switching majors is common in college and there is no reason to expect high school to be any different. Schools are able to accommodate the students who are unsure about their vocation by allowing them to switch lines of vocational study. Young people do not discover their vocation by reading books. If you are to know whether you have talent for and enjoy a line of work, you must experience it. Vocational classes give students a sampling of what it is like to be in the occupation.

Actually having a job in the field would be better still. But outside of the retail and service sectors, employers are not willing to hire young people on a temporary basis. Few employers rotate their new hires through different types of jobs. Once one leaves school, occupational exploration requires job hopping. Employers, however, do not look kindly on job hopping. They see it as a signal of poor motivation or an unwillingness to accept supervision. They seek workers who will stick with the firm and who are already trained and experienced. Consequently, job hopping is not really a satisfactory way of exploring different occupations. Making a switch to an unrelated occupation is very difficult and one's marketability deteriorates each time a switch is made. As vehicles for occupational exploration, schools have drawbacks too--such as the artificiality of the school environment and the limited choice of occupational training programs. But there are compensating advantages: one controls where (which occupation) one hops to and one's marketability suffers less when a switch is made.

Another reason why many high school graduates are unsuccessful in finding good jobs is that schools quite often ignore their requests to send transcripts to prospective employers. To get a good job, one must stand out in the crowd of applicants. Since more than 10 people apply for the typical job, being average is not good enough. Recent high school graduates cannot hope to compete for the better jobs if schools deny employers access to reliable information on a student's performance in high school. If employers know nothing about a student's high school accomplishments, work experience will inevitably become the primary hiring criterion and recent graduates will be at a disadvantage (Hollenbeck and Smith, 1984).

Although the Buckley Amendment requires school officials to share transcripts with employers when a student or graduate signs a release, many schools fail to respond to the signed releases sent by employers. When school officials were asked why they were not responding to the requests, the answer was that they were too busy.[30] Postsecondary institutions were reported to be more cooperative in providing transcript information. Students headed for college receive preferential treatment, for schools seldom fail to respond to requests that transcripts be sent to a college. Schools that are unresponsive to requests for transcripts typically do not inform their graduates of their policy. As a result, recent graduates probably do not realize that their inability to get quality jobs maybe due

in part to the failure of their school to respond to transcript requests in a timely manner. Because high school transcripts are often not sent, are slow to arrive and difficult to understand, most employers have given up requesting them.

19. What is the Optimal Intensity of the Occupationally Specific Component of a High School Vocational Program?

During their four years in high school, 1992 graduates took an average 1.25 Carnegie units of exploratory vocational courses (industrial arts, home economics, etc.), 2.5 units of occupational vocational courses and 17.1 units of other courses. Vocational course taking is wide spread. Fifty-six percent of 1992 graduates earned credits in the business field, 34 percent in trades and 23 percent in technical (often computers) (Boesel et al, 1994b p. II-8). Even though less than 10 percent of 17 year olds characterize themselves as in a vocational-technical program, 48 percent of 1990 high school graduates have completed 4 or more full year vocational courses (Boesel 1994a, p. 95). These student often take courses in more than one vocational field. Only 58 percent of 1992 graduates with 4 or more vocational courses had taken at least four courses in one labor market area. Over the last ten years there has been a decline in the proportion of high school graduates who "concentrate" in one labor market preparation area (Boesel et al, 1994b). A rising share of the students in vocational classes take only a limited number of courses.

Some worry about this trend fearing that the less intensive training will not be rewarded by the labor market. Is this fear justified? How large are the labor market benefits of just two or three vocational courses? Must one take a very intensive program of occupational studies to benefit from the training? Figure 11 and 12 provide answers. Figure 11 plots the 1981-82 employment rate of 1980 high school graduates against the number of vocational courses taken in high school. Figure 12 plots 1981 earnings against vocational coursetaking. Threshold effects appear to be absent. Indeed the first few vocational courses have considerably larger impacts on employment and earnings than the 5th and 6th vocational course.

Econometric analysis of the High School and Beyond data confirms these conclusions (Kang and Bishop 1989). Complete specialization in vocational education which ignores

Figure 11
Impact of Vocational Education
On Employment the Year After Graduation

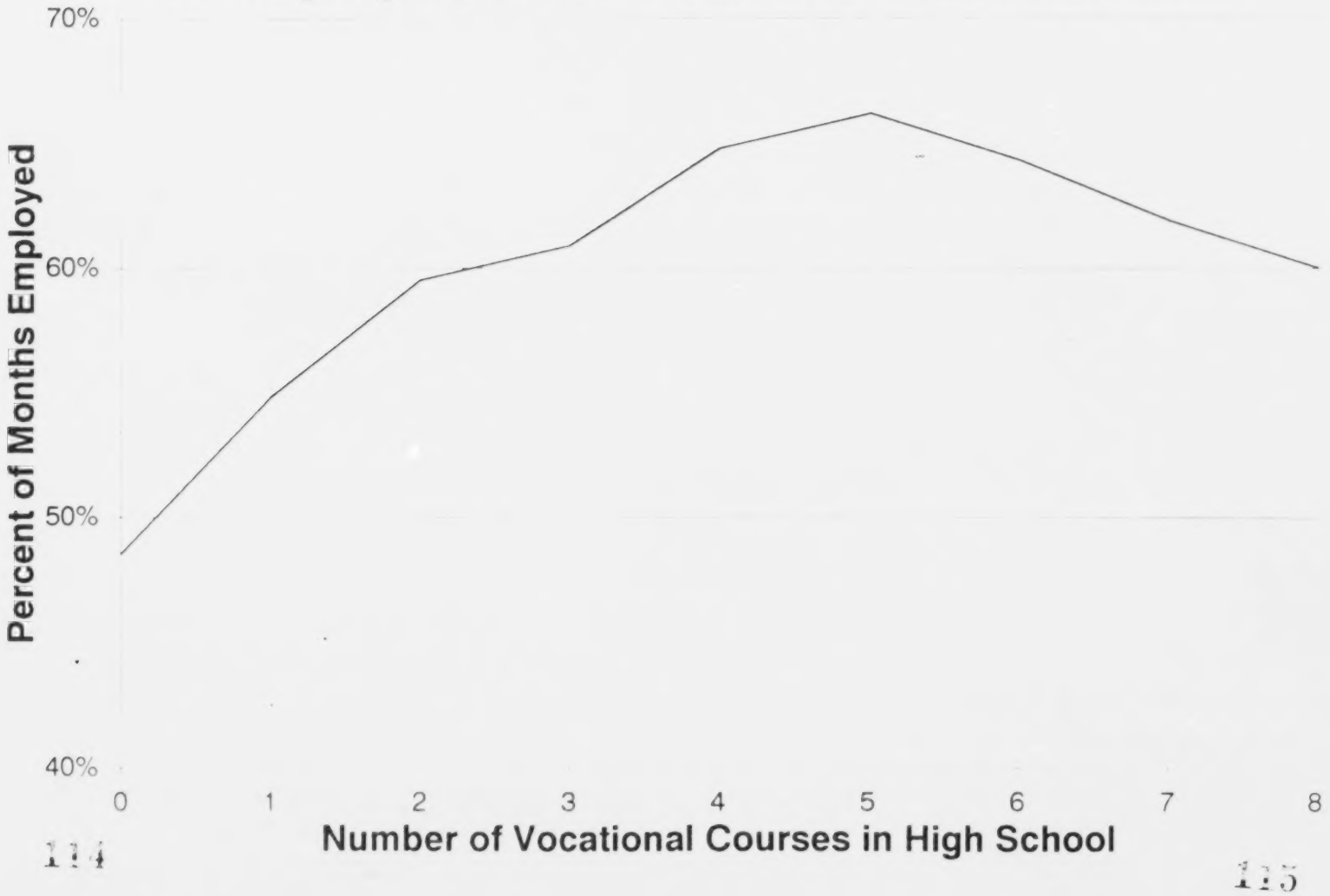
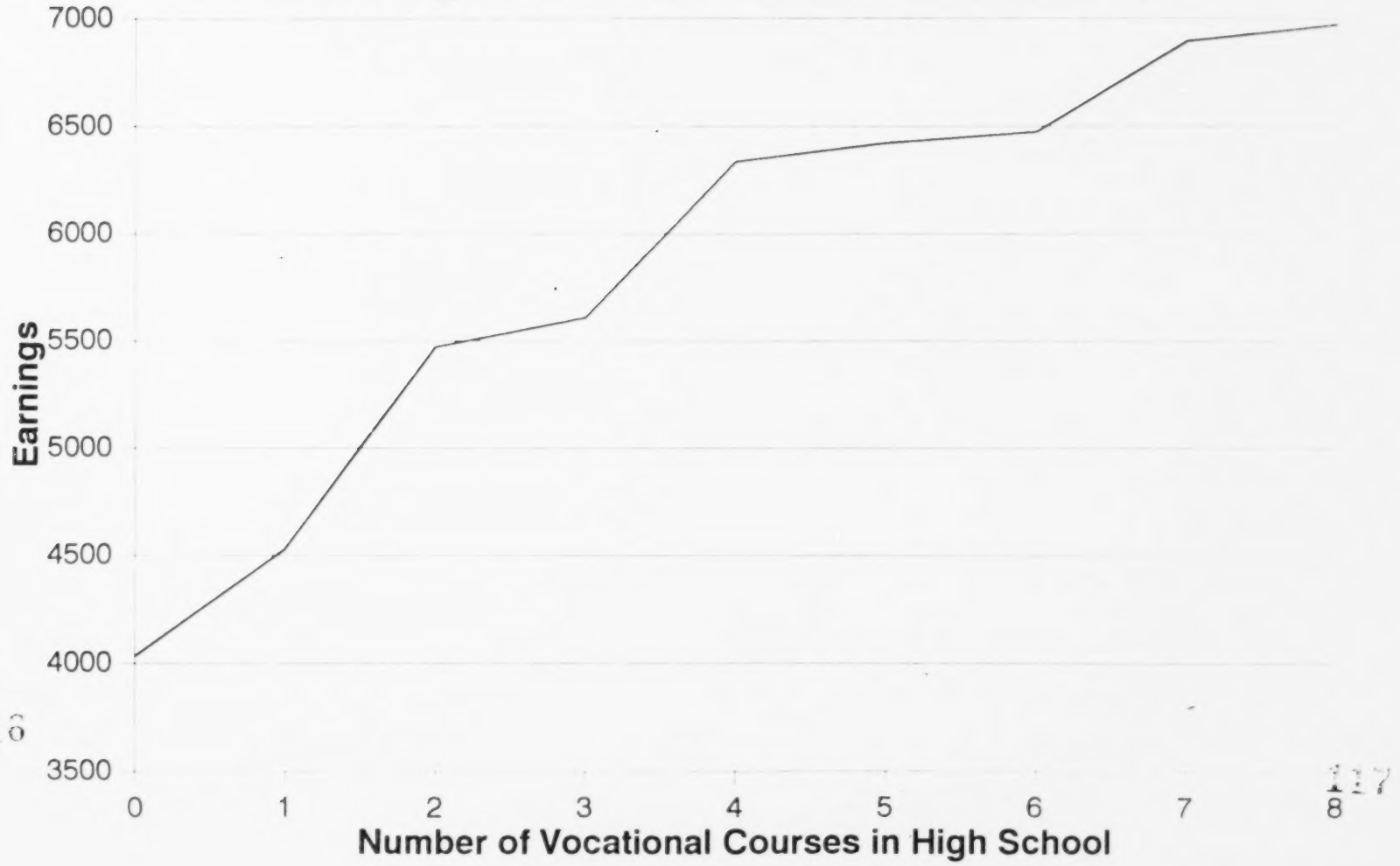


Figure 12
Impact of Vocational Education
On Earnings the Year After Graduation



preparation in basic skills is not as effective as a curriculum that provides both vocational skills and competency in basic skills. Academic and vocational education are complements rather than substitutes. Students who choose to take some modest level of vocational course work benefit greatly relative to those who specialize totally in academic courses, but the benefits of additional vocational courses sharply diminish once 3 or 4 are taken. The implication of this result is that (a) every student who does not have definite plans to attend college full time should be urged to take 3 or 4 courses in an occupational specialty and (b) that vocational students should be counseled against taking an excessive number of vocational courses.[31]

20. Can On-the-Job Learning be Combined with Classroom Learning?

A case can be made that many of the competencies that young people need to learn are taught at work at least as well as in school. Work habits, teamwork and customer service are examples of skills that are probably best learned on a job. Longitudinal studies of American Youth have demonstrated the value of working during the summers between junior and senior year and during senior year.

Students who worked while in high school were generally much more successful in the labor market than those who did not. Figure 13 summarizes unpublished findings regarding the impact of working while in high school taken from Kang and Bishop's (1984) study of the effects of curriculum on labor market success. Holding a job during the summer between junior and senior year had large effects on wages, employment, and earnings. For boys, 30 hours of work per week during the summer between junior and senior years led to 8 percent higher wage rates, 12.5 percent more employment, and 11 percent higher earnings in the period immediately following high school. An equivalent total number of hours worked during the senior year (i.e., averaging 10 hours a week) raised the wage rate of boys by 1.5 percent, employment by 3 percent, and earnings by 8 percent. Holding a job during junior year in high school had practically no effect on labor market success after school. Girls who worked during summers and senior year also experienced substantial gains in employment and earnings.

The magnitude of these effects diminish over time but, nevertheless, remain substantial (Kang, 1984). Compared to those without work experience, those who worked 10 hours per week through the last two years in high school earned 8 to 20 percent more in the first three months after graduation and 5 percent more during the sixteenth through twenty-first month after graduation.

Are these labor market benefits bought at the expense of any undesirable effects of having a job while in school? Greenberger and Steinmier (1981) have noted that high school students who have part-time jobs during the school year are less committed to school and family and are more likely to engage in anti-social behaviors such as theft and substance abuse. They incorrectly interpret this association as evidence that part-time work causes these outcomes. In fact, causation runs primarily in the opposite direction. Studies of the determinants of work while in high school have found that working during the junior and senior years is often a consequence of the student's earlier rejection of the academic goals of the school and alienation from the institution (Hotchkiss 1982, 1984).

Consequently when studying the effects of working during the school year on later academic outcomes, it is essential to use a longitudinal design and to control thoroughly for aspirations, attitudes, grades and academic achievement measured before going to work. Hotchkiss's (1982) analysis of a longitudinal survey of Columbus high school students found that hours worked had no effect on days absent, days tardy, or grade point average. Bishop's (1985) study of changes in test scores, GPA, deportment, and educational plans between sophomore and senior year of the High School and Beyond survey found small but statistically significant negative effects of working during the junior year but no deleterious effect of working as a senior.[32]

21. Is Government Subsidized Customized Training of Incumbent Workers Effective

Rather than always expecting students to come to them, community colleges and area vocational-technical schools need to start delivering training programs at the work site. One way to promote skill development of incumbent workers is for community colleges (or some other public agency) to establish cooperative training ventures with specific local employers. The training could be done by teachers on the college's payroll or by trainers contracted by

the public agency. The training would be customized to meet the firm's specific needs but would be in skills that are also useful at other firms (Office of Technology Assessment 1990, 144-150; Creticos, Duscha and Sheets 1990). Many states have established such programs. Sometimes the training is provided by community college staff, sometimes by private contractors and sometimes by in-house staff. Typically state grants cover one-half of the instructional costs of training. The company pays the other half of instructional costs and all of trainee time costs. Many states and localities now offer this kind of aid to companies that are trying to become more competitive or plan to open or expand plants in the community. Some states give preference to firms where training is part of an effort to implement elements of the high performance work system model. These cooperative efforts expand the training and skills of incumbent workers while simultaneously building closer relationships between business and public community colleges. Proponents of customized training contend it serves as an inducement for new high-tech companies to locate in the state and as an aid to local firms struggling to keep up with fast-changing technology (New York State Education Department 1984). Another benefit of customized training is that the involvement of an educational institution facilitates the award of credentials that will make the skills gained more visible to other employers.

Publicly subsidized institutions are becoming increasingly important providers of skill training that is customized to a particular employer's needs. In other cases, the training program is delivered by a private technical college or institute, an individual or consulting firm hired on a contract basis, or another firm (e.g., the maker of equipment that is being installed at a firm). If these alternative providers are to be given a chance, the public funds set aside for customized training should be administered by a public agency that can select the best local provider and contract for the training in an expeditious manner. The responsibility for administering such a program could be assigned to an education agency, as in New York; to the state's Labor Department, as in California; or councils representing the social partners as occurs in the Job Training Partnership Act. Creticos and Sheets (1990) study of these programs concluded that improvements in business performance did result at the 24 companies studied.

> These improvements were due not to training alone: the training was part of a broader effort to improve productivity, quality and profitability. For example, Northwestern Steel and Wire Co. in Sterling Illinois, wanted to raise

> profits by bringing its costs down to meet those of other U.S. mini-mills. (An industry study had shown that Northwestern's maintenance costs were much higher than the industry average). The company used the state grant to cross-train its maintenance workers; at the same time, Northwestern changed its product mix and took other steps to reduce maintenance costs. Taken together, all of these actions, including the training, succeeded in reducing maintenance costs. The 24 case studies also showed that the State funds allowed the firms to train more workers more quickly than was possible using company funds and that top managers in all companies came to view training much more positively (OTA, p. 145)

The incumbent workers who entered customized retraining programs organized by their employer and funded by California's Employment Training Panel (ETP) Program experienced a modest 3 percent increase in real earnings.[33]

If customized training is to be attractive to firms, application costs-- staff time, paperwork, and delay--must be kept to a minimum. State programs in California, Illinois and New York have demonstrated that it is possible to negotiate and contract for training quickly and at reasonably low cost.

21. Should Systems for Certifying Occupational Skills be Developed?

Many states have developed or are developing systems of assessing and certifying student competence in core academic subjects. Over half the states have minimum competency tests which students must pass to graduate from high school. The Advanced Placement Exams offer high school students the opportunity to get college credit for college level courses ranging from history to computer programming. The College Board is developing Pacesetter Examinations for senior year capstone courses in English, mathematics and science. About half of New York State high school students take Regents Examinations that are reported on their high school transcript and are part of their grade in the course. California is developing a similar system called the Golden State Examinations. The New Standards Project has organized a consortium of states and school districts that is developing methods of assessing competency in mathematics, science, and applied learning.

Most other industrialized nations do not base selection to higher levels of education on the results of aptitude tests like the SAT. Instead, Ministries of Education or regional boards sponsor curriculum-based examinations. Examination results are typically only a part

of the final grade, but they serve as an important yardstick for assessing quality and as a credential used by colleges and employers. The connection between the teacher's competence, the student's effort in school and performance on these exams is clearly visible to all. Consequently, school sponsored achievement exams like those used in Europe, New York State, Alberta, British Columbia, Newfoundland and Quebec generate strong incentives for students to study, for teachers to set high standards and for school administrators to give academic achievement higher priority in the allocation of time and resources. Indeed, it can be shown that these exams had the effects one might predict. Holding the social class background of students constant, students from Canadian provinces with examination systems were substantially (23 percent of a standard deviation) better prepared in mathematics and 18 percent of a standard deviation better prepared in science than students from provinces lacking such exams. The effect of an exam system on mathematics achievement of 13 year olds is larger in a standard deviation metric than the decline in math SAT scores between 1969 and 1980 that has been such a focus of public concern. Other natural experiments yield similar findings. When adjustments are made for ethnicity and social class of SAT test takers, New York State students score 44 points higher on the summed math and verbal SAT than comparable students in other states. The mathematics and science achievement of Swedish high school seniors declined in the years following the elimination of high/medium stakes curriculum-based exams (Bishop 1995). These findings suggest that it would be desirable for states other than New York to establish curriculum-based examination system.

There is a danger, however, that such an examination systems might be designed solely around the needs of post-secondary education, ignoring work place competencies and applied technology. If so, students who need to develop skills valued in the labor market might be forced to spend their time on purely aesthetic subjects. This has been a serious problem in Great Britain and in many developing nations. During the 19th and early 20th century, the supremacy of classical studies in the curriculum of British secondary schools was reinforced by the heavy weight given to the knowledge of Greek and Latin in the civil service exams of the time. The overemphasis on the classics and the corresponding neglect of science and technology was one of the reasons for the relative decline of British industry (Barnett 1972). Indeed the problem was accurately forecast by Herbert Spencer in 1861:

> That which our school courses leave almost entirely out, we thus find to be that which most nearly concerns the business of life. Our industries would cease, were it not for the information which men begin to acquire, as best they may, after their education is said to be finished (Spencer, p. 25).

The job relatedness requirement of the Civil Rights Act will tend to discourage this from happening in the United States, but this is a danger that needs to be guarded against.

The A Nation at Risk report recommendation that all students take a course in computers recognized the need for including applied technology in the curriculum. Somehow, however, geography, a subject that is not taught in most American universities and that no one argues is important in most jobs, has displaced computers as one of the National Governors Association's approved 5 core subjects. Even though the education reform movement marches under a banner of economic renewal, it is in danger of being captured by advocates for traditional subjects like geography, art and music that have little role in improving the nation's productivity or in preparing young people for work. The SCANS's proposal that all high school students be taught budgeting, scheduling and technology was not well received in much of the educational establishment. There is a danger that the emerging system of national assessments in a limited number of academic subjects will result in the U.S. making the same kind of error in the 21st century that the British made in the late 19th century (and which we, with our land grant colleges, avoided).

To avoid this, students must be able to choose to study occupation and industry specific skills (in apprenticeships or the classroom) during the final two years of high school and their accomplishments in these courses need to be assessed and signalled to the labor market.

How should Occupational Competency be Assessed and Signalled?

One example of how the signalling of occupational competency might be accomplished is provided by the Pennsylvania Skills Certificate. In 1987 Pennsylvania began awarding a Pennsylvania Skills Certificates to high school vocational students who demonstrated mastery of their craft by passing the written and hands-on components of the NOCTI Competency Exams. As in the German apprenticeship exams, local employers employing workers in the craft were recruited to serve as judges for the hands-on performance portion of the exam. This certificate program stimulated improvements in the curriculum. In the first year of testing, students did poorly on the competency tests for

clerical occupations. When causes of the deficiency were examined, it was discovered that the problem was not the test but the curriculum which was poorly aligned with current employer needs. The result was an extensive revision of the office education curriculum (J. Cullen, 1988).

What about SCANS competencies like scheduling and budgeting that are supposed to be generic? How might they be taught and assessed. To me, it makes little sense to offer courses that specialize in teaching competencies like scheduling or budgeting or skills like problem solving. There is no room in the curriculum for new courses. Most of these competencies should be taught as part of existing courses such as business management, mathematics, science, economics, construction technology or auto mechanics. Students specializing in one of the construction trades could learn about budgeting and scheduling by applying it to the construction industry. The obvious relevance of the topic to the student's planned career should improve motivation to learn the material. In each course in which a student had been exposed to budgeting, the student would also be assessed. Assessment should occur in the same subject matter context as the teaching because we have no assurance that teaching budgeting in one context will transfer to another. The result would be a series of context specific assessments of competencies that may or may not be generic and transferable. When a student sought a job in construction, the "budgeting" grade for the construction industry application would receive the most attention not the budgeting grade in the economics course or the computer course. If, however, this student sought a clerical job in government, the budgeting grade used in the selection process might be an unweighted average of the budgeting grades in each of the three courses where the subject was covered.

This approach to assessing SCANS competencies has face validity and is likely to meet the job relatedness test of the 1991 Civil Rights Act. Before generic tests of many SCANS competencies could be employed in selection, extensive predictive validity research would be necessary to assure that job relatedness standards are met.

Another reason for preferring an industry or occupational cluster approach to signalling is that it involves incremental evolutionary change rather than a revolution in the way schools are organized and students are taught. Educational programs for non-college bound students have industries and occupations as their organizing focus. It has been shown

in Chapters 10-15 that students who completed these programs do much better in the labor market than the non-college bound students who took academic courses only. Increasingly these programs are using validated assessments of occupational competency to evaluate the effectiveness of their programs, to improve curricula and to signal student competencies to potential employers (National Occupational Competency Testing Institute 1988, 1990). The best strategy is to infuse the teaching of the generic SCANS competencies into existing courses and improve instruction and assessment of occupational competencies.

Should Levels of Occupational Proficiency be Signalled?

For young workers, a system like the new French Baccalaureate (which offers Bac exams in a host of applied technology fields as well the standard academic subjects and awards *Bien, Assez Bien and Tres Bien* distinctions as well as just a pass) is the preferred alternative. Students would be able to choose which exams to prepare for and scores for each subject will be reported so employers will be able to focus on the exams which have relevance to their jobs. School administered exams are more reliable measures of achievement in specific fields because they sample a larger portion of the student's knowledge of the field (the ASVAB General Science subtest, by contrast, allows the student 11 minutes to do 24 items).[34] Thus, even though the topics covered will often be less relevant to the firm's jobs, an average of exam grades in subjects that are job relevant will probably be a better predictor of performance for young workers than conventional employment tests that typically take only an hour to administer.

If the system is to be attractive to employers, it will be necessary for it to signal levels of occupational proficiency, not just a pass versus a fail. When many employers use an occupational competency assessment that signals levels of proficiency in recruitment and selection of new hires, everyone faces a strong incentive to develop their skills. Those planning to look for work after high school will find the incentive especially strong. The best paying firms will find they can ask for higher levels of proficiency than low paying firms, so the reward for learning will become continuous. Whether one begins 9th grade way behind or way ahead, there will be a benefit on the margin to studying hard for it will improve one's job prospects.

The alternative, a pass-fail system of occupational competency assessment, suffers

from at least three very serious drawbacks. The first problem is setting the pass-fail standard. Some employers have job openings requiring a high standard; others require only minimal skills. How would agreement be forged? I foresee the issue ending up in the courts, challenged on civil rights grounds. Wherever the minimum were set, some employers would find it inappropriate and would consequently fail to use the signalling system. A standard that would be appropriate for a two-year community college program would be much too difficult for a high school program that offers only two or three specialized courses. In a democratic society like ours it will not be possible to set the standard so high that most completers of high school vocational programs cannot attain it after two or three specialized classes.

The second problem is that a pass-fail signalling system will be used in the early phases of the selection process to screen out "unqualified" applicants, not in the final phases where the short list of candidates assessed in depth. Since the coverage of the assessment and signalling system will not be universal, traditional methods of selection will have to remain in place. Most employers use a multiple hurdles approach to selection whereby a large pool of applicants are winnowed down to just a few interviewees. The pool of applicants who enter second and later rounds of consideration for a job will be those who provided no skills test information and those who were declared "qualified" by the test. The fact that they passed the exam will probably not count for much in the later rounds because this information is not be available for the applicants who did not take the test.

Now imagine yourself a job applicant who is trying to decide whether to participate in the skills assessment and signalling system. Participating will hurt you a lot, if you fail the test and help you only a little, if you pass. Would you participate? Probably not. Consequently, if participation in the skills assessment system is voluntary [as has been promised], many young people are going to choose not to be assessed. This will reduce the proportion of applicants for which pass-fail information is available, and further discourage employer use of the assessment system. The only way to avoid this problem is to signal a variety of levels of proficiency and to offer detailed information on capabilities so that the assessment/signalling system becomes a part of the final selection process not just initial screening.

A third drawback of a pass-fail system is that it weakens incentives for students to

develop high levels of proficiency. Young people entering occupational training programs vary a great deal in ability, basic skills and background in the field.[35] When this is the case, incentives for effort are stronger on average when rewards rise continuously with the final level occupational proficiency (ie. levels of competency are signalled) than when there is single large reward attached to achieving above some absolute standard (ie. the signal reveals only whether one has passed). Under the single cutoff reward system, many students pass the standard without exertion and are, therefore, not stimulated to greater effort by the incentive. Other students calculate that the effort required to achieve the standard is so great and the probability of success are so small, the possible reward is insufficient to warrant making the effort. Consequently, they give up on the idea of meeting the standard. Only a portion of the students find the single absolute cutoff with reward attached an incentive for greater effort (Kang 1985).

A system of assessing and signalling entry level occupational competencies can improve the incentives for students to develop occupational skills only if many employers use it. Employers will use such a system only if the information it provides adds value to their selection decisions. A pass-fail only signalling system throws away much of information about the graduate's proficiency and thus lowers the value added of the system.

The Benefits of an Industry Wide Skills Assessment System

The rewards students receive for developing occupational skills and the incentives for schools and companies to offer high quality occupation training would be strengthened if students/trainees were working towards nationally recognized certificates (see Chapter 6's discussion of the reasons for underinvestment in development of occupational skills. Industry wide systems with common standards across educational institutions and firms is the preferred way of certifying training experiences. Trade associations in banking and construction and a variety of other industries have sponsored the development and dissemination of competency tests that are necessary to create a truly uniform system of certification. Although most occupational competency tests have been designed for certifying the vocational training provided by schools, they could be adapted for use in certifying apprenticeships and other forms of on-the-job training as well. The federal government is now encouraging the development of these competency certification schemes

by awarding development contracts to trade associations (Wills 1993).

Such a system would probably result in everyone--teachers, students, trainees, employer and supervisors--taking the occupational skill development more seriously. The certificate and the recognition it signified would be a source of pride to the students and workers. The certificates would also signal what has been learned to schools and employers and improve the worker's marketability. The amount and quality of occupational training would be better recognized by the labor market, resulting in better matches and more effective use of people's skills and stronger incentives to provide broader and higher quality training.

Once skill certification systems have been developed and are operating satisfactorily, state governments might want to explore the feasibility of encouraging occupational skill development by making the number of students/workers obtaining skill certifications a target of subsidy or a part of the reporting system by which state governments oversee the training programs they manage or contract for. Vocational schools, for example, might be funded partially on the basis of the number of students completing specific qualifications. Workers who demonstrated their skills to an external certification board might receive prizes and/or make their firm eligible for tax credits.

A by product of targeting subsidies in this way would be to encourage schools and employers to use the certification system. Without such incentives to attract workers, schools and firms into the skill certification process, it is uncertain whether the skill certification system will gain the scale necessary for survivability.

On the other hand, there are potential drawbacks to the federal government subsidizing training in a way that generates an incentive for training vendors to use a specific occupational credentialing system. Generous subsidies would be very costly. When there are no such inducements, a credentialing system that does not add value will not be used by employers and will therefore not distort the labor market. Little will be lost. If schools and companies are being subsidized to participate in a credentialing system and it is poorly designed, the labor market might become more distorted than it was before the system was created.[36] These problems, however, do not arise when state governments use the award of skill certificates as one of a series of performance indicators for oversight of state funded community colleges and training programs.

22. Expanding Computer Education

The A Nation at Risk report recommendation that all students take a course in computers recognized the need for including computers in the curriculum. The payoff to increased knowledge of the applications programs found on modern personal computers is extremely high. Alan Kruger's analysis of 1984 data from the High School and Beyond Survey has found that holding years of schooling, grades and test scores constant, that young people who used a computer at work had 10 percent higher wage rates. When one focusses solely on secretaries with a 12th grade education, the premium for computer use/skills was 9 percent in both 1984 and 1989. Analysis of CPS data found that holding schooling, one-digit occupation and 48 industry dummies constant that the premium paid to those who use a computer at work was 9 percent in 1984 and 14 percent in 1989. This increase in the return to computer skills occurred in the face of a nearly 50 percent increase from 1984 to 1989 in the proportion of workers who use a computer. For a skill premium to grow in the face of such a massive increase in supply of the skill, demand for this skill must have grown at an incredible rate during the 1980s.

It does not require a great deal of training to become proficient at word-processing and other applications programs. In fact, it is so inexpensive to provide that 59 percent of the temporary help agencies surveyed by Kruger in 1991 offered free training in word processing to people seeking employment through the agency. The trainees attended the word processing classes on their own time. At these temporary help agencies, the mean hourly rates of pay for secretaries with and without computer skills were $12.77 and $9.14 respectively. "The fact that temporary help agencies find it profitable to provide computer training to the workers they place suggests there is a substantial return to computer skills (Kruger, 1993, p. 47)."

Computer skills not only pay off in the labor market, they pay off in college as well. College students use computers to do homework, to organize class notes, to write term papers and lab reports, to obtain information from local and remote libraries and to communicate with friends. Spreadsheet, data base and graphics programs are needed for recording and analyzing data from science experiments and for doing projects and homework in business or engineering classes. Students who do not have these skills are at

a terrible disadvantage.

Here is a field of vocational study that cries out for expansion. Word processing, accessing the Internet and using spread sheet and graphics packages are generic skills that every single high school student should learn. Upper secondary school students see the usefulness of these courses. Tenth graders taking such courses described them as "Very Useful" for their career 53 percent of the time and as of "No Use" only 6 percent of the time (LSAY, Q. AACOMF)(see Table 18). However, only 58 percent of lower secondary school students and 43 percent of upper secondary school students report using computers at school (U.S. Census Bureau, Current Population Reports, 1991). The decline in computer use with age is particularly worrisome.

This technology changes rapidly and requires constant updating of hardware, software and humanware (teacher skills). Students should be taught on modern machines using state of the art applications programs such as Microsoft Office 6.1, Lotus Smartsuite or Perfect Office. When they get to university or take a job, they will be able to start work immediately. For many school districts, the $3000 price tag for a modern Pentium PC with DOS, Windows and Microsoft Office included seems extremely high. However, the computers will remain in use for more than 5 years and will be used about 1000 hours a year (6 hrs/day times 180 days). This means that over the lifetime of the equipment, hardware and software combined cost only $0.56 per hour the equipment is being used. Another way to keep costs down is to hire students as assistants in the computer lab.

23. Should High School Vocational Education Become More Rigorous?

While computers are clearly the most pervasive technology we interact with on a daily basis, it is not the only such technology. The findings presented in Chapters 3, 4 and 5 suggest that students headed into technical training programs or directly into a job should receive a thorough technology education.

An example of the kind of course that is needed is the Principles of Technology (PT) course developed by a consortium of vocational education agencies of 47 American and Canadian state/provincial governments in association with the Agency for Instructional Technology and the Center for Occupational Research and Development. This 2 year

applied physics course is both academically rigorous and practical. Each six day subunit deals with the unit's major technical principle (eg. resistance) as it applies to one of the four energy systems--mechanical (both rotational and linear), fluid, electrical and thermal. A subunit usually consists of two days of lectures/discussion, a math skills lab, two days of hands-on physics application labs, and a subunit review. This approach appears to be quite effective at teaching basic physics concepts. When students enrolled in regular physics and Principles of Technology courses were tested on basic physics concepts covered in the PT course at the beginning and end of the school year, the PT students started out behind the regular physics students but obtained an average score of 81 at completion as compared to an average of 66 for those completing a physics course (Perry 1989). Another study by John Roper (1989) comparing PT and physics students obtained similar results. In 29 states students get science and/or math credit when they take PT. Similar courses in applied biology/chemistry and in applied mathematics have been developed. This is an area of study that needs more attention than it has been getting from educational reformers and curriculum developers.

An argument that is often made for vocational education is that it helps motivate students who have been doing poorly in core academic subjects to apply themselves to learning English and mathematics by showing its applications in a real work setting. It is also argued that, by offering opportunities for more concrete/hands-on type of learning, vocational education reduces dropout rates of at-risk students. Indeed, there is research support for this claim. Kulik's review of the literature concludes that the option of participating in vocational education lowers drop out rates (Kulik 1994)

One possible explanation of this dropout reducing effect is that students may view these courses as more relevant to their career plans. When 10th graders were asked to rate career utility on a five point scale, "very useful" was the description given by 58 percent of business/vocational classes, by 28 percent of science students in science courses and 47 percent of math students (see Table 18). Another possible explanation is that at risk students find vocational courses to be easier for them than academic courses. When asked "How difficult or easy is___ course?," 54 percent characterize their vocational course as "very easy," while only 20-23 percent so characterize their science and mathematics courses. When asked to respond to "How much does the ___ course challenge you to use your

Table 18
ASSESSMENTS OF CAREER UTILITY, CHALLENGE AND DIFFICULTY OF HIGH SCHOOL COURSES TAKEN BY SOPHOMORES FALL 1987

COURSE (Percent taking)	Career Utility: Very Useful	Career Utility: No use	Challenge: A lot	Challenge: Never	Difficulty: Very Diffic.	Difficulty: Very Easy	No Home-work
Science (88%)	28%	23%	51%	6%	16%	20%	9%
Math (95%)	47	13	55	7	19	23	8
English (98%)	53	9	36	10	9	31	13
Social Stud.(68%)	18	27	32	9	11	33	11
For. Lang. (51%)	21	22	42	8	14	28	6
Bus/Vocat. (54%)	58	10	34	16	6	54	60
Computer (9%)	53	6	35	10	12	34	42

Source: Longitudinal Survey of American Youth, 10th Grade Fall 1987, The questions were word as follows: "How useful do you think the course will be to you in your career?", "How much do the ____ course challenge you to use your mind?", "How difficult or easy is the ____ course for you?" and "How many hours of homework do you have for this class in an average week?"

mind?" on a 5 point scale ranging from "challenges a lot" to "never challenges", 16 percent of the vocational courses were placed in the bottom response category while only 6-7 percent of the mathematics and science courses were so classified. Sixty percent of business and vocational classes assign no homework.

In my view these statistics imply that despite the demonstrated success of vocational education in helping students get better jobs, that vocational education is not now achieving its promise. It is well known that achievement levels in the academic subjects taught in most American secondary schools are very low.[37] What this data implies is that the expectations placed on vocational students are too low, not just in their academic classes but in their vocational classes as well. As a consequence, many graduates of secondary school vocational programs do not have the occupational skills that employers are seeking and some employers are turning to post-secondary voc-tech institutions to meet their needs for technically qualified workers.

Identifying problems, however, is a lot easier than solving them. American senior high school students average only 3.8 hours of homework a week while their Japanese counterparts average over 19 hours a week (Juster and Stafford 1990). Unfortunately, the sentiment expressed by one student, **"You"re going to work your whole life,..[High school should be a place to] enjoy life and have fun"** (Powell et al, 1985, p 43) is quite common. Sixty-two percent of 10th graders agree with the statement, "I don't like to do any more school work than I have to" (Longitudinal Survey of American Youth or LSAY, Q. AA37N). Many of these students end up in vocational courses. When one asks vocational teachers to raise their standards, many complain that students will not take their courses if they set the expectations too high. Principles of Technology is a demanding course. Student fear of its heavy work demands has been a barrier to its spread. Powell describes "An angry math teacher [who remembering] the elimination of a carefully planned program in technical mathematics for vocational students simply because not enough signed up for it,...[said] 'Its easy to see who really makes decisions about what schools teach: the kids do.'(p. 9)"

How then can students be convinced to choose rigorous technical and occupational programs and work hard to excel in them? The answer is by (1) developing rigorous courses that teach students concepts and material that they will use after leaving high school, (2)

defining accomplishment in a way that students who work hard will be successful, (3) organizing apprenticeship programs for high skill occupations, (4) measuring the student's performance using a valid external assessment and then (5) insuring that accomplishment is recognized and rewarded by the labor market.

Usefulness is essential for three reasons. First, the social benefits of learning derive from the use of the knowledge and skills not from the fact they are in someone's repertoire. Secondly, skills and knowledge that are not used deteriorate. Consequently, if learning is to produce long term benefits, the competencies developed must continue to be used after the final exam (either in college, the labor market or somewhere else). Finally, usefulness is essential because students are not going to put energy into learning things they perceive to be useless. Furthermore, the labor market is not in the long run going to reward skills and competencies that have no use. Indeed, selecting workers on the basis of competencies that are not useful in the company's jobs will in the United States generally be a violation of Title VII of the Civil Rights Act.

It is also essential that the occupational competencies developed by students be assessed and credentialed not just by the teacher but by some external group--local employers or a government sponsored board. This simultaneously accomplishes three goals: it helps to insure that the curriculum is both up to date and rigorous, it signals to prospective employers the skills that the student has developed and generates stronger economic incentives for the student to put greater effort into the course.

VII. Summary

Applied technology courses taken in American secondary schools significantly increase the wages and earnings of graduates who do not go to college. Tests assessing technical competence are powerful predictors of wage rates and earnings of young males and highly valid predictors of training success and job performance in technical, craft and industrial occupations. A one population SD increase in technical competence raises the average earnings (regardless of occupation) of young men by $1333. per year in 1985 dollars. Averaging over the six non-clerical non-combat occupations, and assuming that the standard deviation of true productivity is 30 percent of average compensation, a one population SD

increase in all four of the technical subtests [holding math, reading, vocabulary and science test scores constant] is about 11.5 percent of average compensation.[38] With a working life of 40 years and a real discount rate of 5 percent, the present discounted value of such a learning gain is about $79,000 in 1992-93 dollars. These results imply that broad technical literacy has very large payoffs for workers who use and/or maintain equipment that is similar in complexity to that employed in the military.

The skills taught in typical trade and technical programs raise productivity and yield substantial labor market benefits if jobs are found in a related field. These benefits alone are sufficient to justify trade and technical programs (Bishop 1989a).

REFERENCES

Altonji, Joseph. "The Effects of High School Curriculum on Education and Labor Market Outcomes." Chapter 3 of a report to the Department of Education from the National Center on Education and Employment, Department of Economics, Northwestern University, December 1988.

American Institutes for Research in the Behavioral Sciences. "Development and Evaluation of Vocational Competency Measures." Palo Alto, Calif.:American Institutes for Research, December, 1982.

Barnow, Burt S. Government Training as a Means of Reducing Unemployment. ICF Incorporated, August, 1985.

Barron, John M.; Berger, Mark C. and Black, Dan A. (1993a) "Do workers pay for On-The-Job Training?" Center for Business and Economic Research Working Paper #E-169-93, University of Kentucky, June, 1-28.

Bogue, Grady E. and Brown, Wayne. "Performance Incentives for State Colleges." Harvard Business Review, November-December, 1982.

Bice, Garry R., and Brown, Ralph. Selected Information and Vocational-Technical Education in Tennessee for the School Year 1972-73, Information Series No. 20. Nashville, TN: Tennessee State Department of Education, Division of Vocational-Technical Education. Tennessee University Knoxville, Occupational Research and Development Coordinating Unit, 1973. ED 091 516 CE 001 283.

Bishop, John. "The Effect of Public Policies on the Demand for Higher Education." Journal of Human Resources, Vol. XII, No. 3, Summer 1977a.

Bishop, John H. and Van Dyk, Jane. "Can Adults be Hooked on College? Some Determinants of Adult College Attendance," Journal of Higher Education. Vol. 48, No.1, January/February 1977b, 39-62.

Bishop, John. The Social Payoff for Occupationally Specific Training: The Employers' Point of View. Columbus: The National Center for Research in Vocational Education, The Ohio State University, November, 1982.

Bishop, John. Preparing Youth for Employment, Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1985.

Bishop, John H. "The Recognition and Reward of Employee Performance." Journal of Labor Economics, Vol. 5, No. 4, pt 2, October 1987a, pp. S36-S56.

Bishop, John. "Vocational Education for At-Risk Youth: How to Make it More Effective." Center for Advanced Human Resource Research Discussion Paper # 88-12, Cornell Univ. 1988.

Bishop, John. (1998) "Occupational Competency as a Predictor of Labor Market Performance." Report prepared for the Office of Technology Assessment, Center for Advanced Human Resource Studies Discussion Paper 88-20, 1988, 1-62.

Bishop, John. "Toward More Valid Evaluations of Training Programs Serving the Disadvantaged" Journal of Policy Analysis and Management, Vol. 8, No. 2, Spring 1989a, pp. 209-229.

Bishop, John H. "Occupational Training in High School: How can it be Improved?" Economics of Education Review, 1989b.

Bishop, John (1989c) "The Productivity Consequences of What is Learned in High School." Journal of

Curriculum Studies,

Bishop, John H. "Job Performance, Turnover and Wage Growth." Journal of Labor Economics, Vol. 8, no. 3, July 1990a, 363-386.

Bishop, John. (1992a) "Is a Skills Shortage Coming? An Evaluation of the Bureau of Labor Statistics Projections for 2005." Workforce, Spring, 1992a.

Bishop, John H. (1992b) "The Impact of Academic Competencies on Wages, Unemployment and Job Performance." Carnegie-Rochester Conference Series on Public Policy, North Holland, Vol. 37, December 1992, 127-194.

Bishop, John. (1993a) The Economic Consequences of Schooling and Learning. Center for Advanced Human Resources Research Discussion Paper 93- , forthcoming from ILR Press.

Bishop, John. (1993b) "The Impact of Previous Training in Schools and on Jobs on Productivity, Required OJT, and Turnover of New Hires," Private Sector and Skill Formation: International Comparisons, edited by Lisa Lynch, National Bureau of Economic Research, Chicago: Univ. of Chicago Press.

Bishop, John; Blakemore, Arthur; Low, Stuart. "High School Graduates in the Labor Market: A Comparison of the Class of 1972 and 1980." Columbus, Ohio: National Center for Research in Vocational Education, 1985.

Bishop, John and Stevens, David. (1985) "Employer Provided Work-Skills Enhancement in most Recent Full-Time Job Held: Evidence from the 1984 Second followup of the HSB Seniors Cohort." Columbus, Ohio: National Center for Research in Vocational Education, 1-19.

Bishop, John and Carter, Shani. "The Worsening Shortage of College Graduate Workers" Educational Evaluation and Policy Analysis, Fall 1991.

Bishop, John and Kang, Suk. "On-the-Job Training/ Sorting: Theory and Evidence" National Center for Research in Vocational Education, Ohio State University, 1984.

Bishop, John and Kang, Suk. "A Signaling/Bonding Model of Employer Finance of General Training." Center for Advanced Human Resource Studies, Cornell University, Ithaca, New York, 1988.

Bishop, John and Kang, Suk. (1990) "Why are Wage Profiles so Flat During the First Year on the Job?" Center for Advanced Human Resource Studies Working Paper 89-18, Cornell University, Ithaca, New York.

Blanchflower, David and Lynch, Lisa, (1994) "Training at Work: A Comparison of U.S. and British Youths." Private Sector and Skill Formation: International Comparisons, edited by Lisa Lynch, National Bureau of Economic Research, Chicago: Univ. of Chicago Press, 233-260.

Bloom, Howard S.; Orr, Larry; Cave, George; Bell, Stephen; Doolittle, Fred. The National JTPA Study: Title II_A Impacts on Earnings and Employment at 18 Months. Executive Summary. Bethesda, Md.: Abt Associates, May 1992.

Boesel, David, ed. National Assessment of Vocational Education: Interim Report to Congress. Washington, D.C.: U.S. Department of Education, January 1994, 1-407.

Boesel, David; Hudson, Lisa; Deich, Sharon and Masten, Charles. National Assessment of Vocational Education: Final Report to Congress. Washington, D.C.: U.S. Department of Education, June 1994, 1-407.

Booth-Kewley, S. (1983). Predictive validation of Armed Services Vocational Aptitude Battery forms 8, 9, and 10 against performance at 47 Navy schools. San Diego, CA: Navy Personnel Research and Development Center.

Bowers, Norman and Swaim, Paul. (1992) "Probing (Some of) the Issues of employment related Training: Evidence from the CPS." Washington D.C.: Economic Research Service, U.S. Department of Agriculture, 1-36.

Bureau of National Affairs, (1993) "Text of Rules and Regulations", Wages and Hours. New York, Bureau of National Affairs.

Buechtemann, Christoph, Schupp, Jurgen and Soloff, Dana. (1993) "Roads to Work: school-to-work transition patterns in Germany and the United States." Industrial Relations Journal, Vol. 24, no 2, 97-111.

Campbell, John P. "Validation Analysis for New Predictors" Paper presented at Data Analysis Workshop of the Committee on the Performance of Military Personnel, Baltimore, December 1986.

Campbell, Paul B.; Elliot, Jack; Hotchkiss, Larry; Laughlin, Suzanne and Seusy, Ellen. "Antecedents of Training-Related Placement." Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1987a.

Campbell, Paul B.; Elliot, Jack; Laughlin, Suzanne and Seusy, Ellen. "The Dynamics of Vocational Education Effects on Labor Market Outcomes." Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1987b.

Campbell, Paul B.; Basinger, Karen S.; Dauner, Mary Beth; and Parks, Marie A. "Outcomes of Vocational Education for Women, Minorities, the Handicapped, and the Poor." Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1986.

Campbell, Paul B.; Orth, Mollie N.; and Seitz, Patricia. Patterns of Participation in Secondary Vocational Education. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1981.

Chalupsky, Albert B. Testing Competence in Vocational Education: An Overview. Proceedings of the American Statistical Association, Social Statistics Section, 1982.

Cave, George; Bos, Hans; Doolittle, Fred and Toussaint, Cyril. (1993) Job Start: Final Report on a Program for School Dropouts. New York: Manpower Development Research Corporation, 1-319.

Commission on Workforce Quality and Labor Market Efficiency, Investing in People: A Strategy to Address America's Workforce Crisis. Wash, DC: Department of Labor, 1989.

Commission on the Skills of the American Workforce. America's Choice: High Skills or Low Wages! National Center on Education and the Economy, Rochester, New York, June 1990.

Conroy, William G., Jr., and Diamond, Daniel E. The Impact of Secondary School Occupational Education in Massachusetts. Lowell, MA: University of Lowell, College of Management Science, Sprint 1976. ED 122 095.

Dunbar, Stephen B. and Linn, Robert L. "Range Restriction Adjustments in the Prediction of Military Job Performance". Prepared for Committee on the Performance of Military Personnel, National Research Council / National Academy of Sciences. September 1986.

Elias, Peter, Hernaes, Erik and Baker, Meredith. (1994) "Vocational Education and Training in Britain and

Norway." Private Sector and Skill Formation: International Comparisons, edited by Lisa Lynch, National Bureau of Economic Research, Chicago: Univ. of Chicago Press, 283-298.

Eck, Alan. (1993) "Job-Related Education and Training: Their Impact on Earnings." Monthly Labor Review, October, 21-38.

Feldman, Ruth. Whatever Happened to the Quiz Kids. Chicago Review Press, 1982.

Felstehausen, Joyce L., et al. Follow-Up Report on Illinois "Class of 71" Occupational Program Alumni, Final Report. Charleston: Eastern Illinois University, Center for Educational Studies, June 1973. ED 087 866.

Flynn, Patricia (1988) Facilitating Technological Change: The Human Resource Challenge. Cambridge, Mass.: Ballinger

Ghiselli, Edwin E. "The Validity of Aptitude Tests in Personnel Selection." Personnel Psychology. 1973: 26, 461-477.

Goldberger, Arthur S. "Linear Regression after Selection." Journal of Econometrics. Vol.15, 1981, pp. 357-366.

Grasso, J. T., and Shea, J. R. Vocational Education and Training: Impact on Youth. Berkeley, CA: The Carnegie Council on Policy Studies in Higher Education, 1979.

Greenberger, Ellen, and Steinberg, Laurence D. "Part-Time Employment of In-School Youth: An Assessment of Costs and Benefits." Final Report. Irvine: University of California, 1981.

Grubb, Norton. (1994) The Returns to Education and Training in the Sub-baccalaureate Labor Market: Evidence from the Survey of Income and Program Participation. Berkeley, National Center for Research in Vocational Education.

Grubb, Norton. "Response to Comment." Journal of Human Resources, Vol. 30, No. 1, Winter 1995, 222-228.

Grubb, Norton. "The Varied Economic Returns to Postsecondary Education: New Evidence from the National Longitudinal Study of the Class of 1972." Journal of Human Resources, Vol. 28, No. 2, Spring 1993, 365-382.

Gustman, Alan L., and Steinmeier, Thomas L. "The Relation Between Vocational Training in High School and Economic Outcomes." Paper prepared for the Division of Technical Systems in the Office of Technical and Analytic Systems, Office of the Assistant Secretary for Planning and Budget, U.S. Department of Education. Hanover, NH: Darthmouth College, July, 1981.

Haber, S., J. Cordes. and J. Barth. "Employment and Training Opportunities in Small and Large Firms." U.S. Small Business Administration, June 1988.

Halasz, Ida M., And Behm, Karen S. "Time on Task Selected Vocational Education Classes." Columbus: The National Center for Research in Vocational Education, The Ohio State University, January 1983.

Halasz, Ida M.; Behm, Karen S.; and Fisch, Marta R. "Influences on Secondary and Postsecondary Vocational-Technical Student Time on Task." Columbus: The National Center for Research in Vocational Education, The Ohio State University, January 1984.

Hamel, Harvey R., "Job Tenure of American Workers, January 1963", Monthly Labor Review, October 1963, Reprint No. 2426, pgs. 1145-1163.

7

Hamel, Harvey R., "Job Tenure of Workers, January 1966", Monthly Labor Review, January 1967, pgs. 31-45.

Haney, Walt, and Woods, Elinor. "Secondary Vocational Education, Basic Skills, and Employment." The Huron Institute, Cambridge, MA., May 1982.

Hayghe, Howard, "Job Tenure of Workers January 1973", Monthly Labor Review, December 1974, Vol. 97, pgs. 53-73.

Hersch, Joni, "Equal Employment Opportunity Law and Firm Profitability", Journal of Human Resources, Winter 1991, pgs. 139-153.

Hollenbeck, Kevin and Smith, Bruce. Selecting Young Workers: The Influence of Applicant's Education and Skills on Employability Assessments by Employers. The National Center for Research in Vocational Education, The Ohio State University, January 1984.

Hollenbeck, Kevin and Wilkie, Richard. "The Nature and Impact of Training: Evidence From The Current Population Survey." In Training and Human Capital Formation, edited by John Bishop, Kevin Hollenbeck, Suk Kang and Richard Wilkie, The National Center for Research in Vocational Education, The Ohio State University, July 1985.

Horvath, Francis W., "Job Tenure of Workers in January 1981", Monthly Labor Review, September 1982, pgs. 34-36.

Hotchkiss, Lawrence; Bishop, John H.; and Gardner, John. Effects of Individual and School Characteristics on Part-Time Work of High School Seniors. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Hotchkiss, Lawrence. "Effects of Work Time on School Activities and Career Expectations." Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Hubbard, R. Glenn and Judd, Kenneth L. "Liquidity Constraints, Fiscal Policy and Consumption" Brookings Papers on Economic Activity, 1986, #1, 1-60.

Hunter, J.E. "Causal Analysis, Cognitive Ability, Job Knowledge, Job Performance, and Supervisor Ratings." In Performance Measure and Theory, edited by S. Lundy, F. Zedeck, and S. Cleveland. Hillsdale, NJ: Lawrence Erlbaum, 1983.

Hunter, J.E., and Hunter, R. F. "The Validity and Utility of Alternative Predictors of Job Performance." Psychological Bulletin, 96, no. 1 (1984): 72-98.

Hunter, John E.; Crosson, James J. and Friedman, David H. "The Validity of the Armed Services Vocational Aptitude Battery (ASVAB) For Civilian and Military Job Performance, Department of Defense, Washington, D.C., August, 1985.

Hunter, John E.; Schmidt, Frank L. and Judiesch, Michael K. "Individual Differences in Output as a Function of Job Complexity." Department of Industrial Relations and Human Resources, University of Iowa, June 1988.

Instructional Materials Laboratory. The Ohio Vocational Education Achievement Test Program. The Ohio State University, 1988.

International Association for the Evaluation of Educational Achievement (IAEEA) Science Achievement in Seventeen Nations, New York, Pergamon Press, 1988.

Juster, Thomas and Stafford, Frank. "The Allocation of Time: Empirical Findings, Behavioral Models and Problems of Measurement." Ann Arbor, Mich.: Survey Research Center, Institute for Social Research, 1990.

Kane, Thomas and Rouse, Cecilia. (1995)(1993) "Labor Market Returns to Two and Four-Year College: Is Credit a Credit and Do Degrees Matter?" National Bureau of Economic Research Working Paper # 4268.

Kane, Thomas and Rouse, Cecilia. (1995) "Comment on W. Norton Grubb, "The Varied Economic Returns to Postsecondary Education: New Evidence from the Class of 1972." Journal of Human Resources, Vol. 30, # 1, Winter 1995, 205-221.

Kang, Suk. "Time Profile of Youths' Labor Market Outcomes: An Analysis of High School and Beyond Data." In High School Preparation for Employment, edited by Lawrence Hotchkiss and Suk Kang, pp. 95-135. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984.

Kang, Suk and Bishop, John. "The Effect of Curriculum on Labor Market Success Immediately After High School" Journal of Industrial Teacher Education, Spring, 1986

Kang, Suk and Bishop, John. "Vocational and Academic Education in High School: Complements or Substitutes." Economics of Education Review. Vol. 8, No. 2, 1989, pp. 133-148.

Kominski, Robert. (1990) What's its Worth?, Educational Background and Economic Status: Spring 1987. U.S. Bureau of the Census, Current Population Reports, P-70, No. 21.

Kominski, Robert and Sutterlin, Rebecca. (1992) Whats its Worth?, Educational Background and Economic Status: Spring 1990. U.S. Bureau of the Census, Current Population Reports, P-70, No. 32.

Krueger, Alan. "How Computers Have Changed the Wage Structure: Evidence from Micro Data, 1984-1989." Quarterly Journal of Economics, Feb. 1993, 33-60.

Kulik, James A. High School Vocational Education and Curricular Tracking. Ann Arbor, Mich: University of Michigan, January 1994, 1-84.

Lengermann, Paul. "The Wage Impact of Training: Employer vs. Government vs Individual Sponsorship." New York State School of Industrial and Labor Relations, Cornell University, May 1994.

Lillard, L. and H. Tan. Private Sector Training: Who Gets it and What are Its Effects. Monograph, R-331-CO1/RC, Santa Monica, Calif: Rand Corp, 1986.

Longitudinal Survey of American Youth. "Base Year Code Book: Fall 1987-Spring 1988" Dekalb, Ill: Public Opinion Laboratory, 1988.

Lord, F. & Novick, M. (1968). Statistical theories of mental test scores. Reading, MA: Addison-Wesley.

Lowenstein, Mark and Spletzer, James R. (1993) "Training, Tenure and Cost Sharing." Office of Research and Evaluation, Bureau of Labor Statistics, December draft, 1-50.

Lynch, Lisa. "Private Sector Training and the Earnings of Young Workers." American Economic Review, March 1992, 299-312.

McKinney, Floyd L.; Franchak, Stephen L.; Halasz, Ida; Morrison, Irene; and McElwain, Douglas. Factors Relating to the Job Placement of Former Secondary Vocational Educational Students. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Maguire (1993)

Maier, Milton H.; and Grafton, Francis. "Aptitude Composites for the ASVAB 8, 9 and 10." Research Report 1308, U. S. Army Research Institute for the Behavioral and Social Sciences, Alexandria, VA. May, 1981.

Maier, M.H., & Truss, A.R. (1983). Validity of the ASVAB forms 8, 9, and 10 for Marine Corps training courses: Subtests and current composites (Memorandum No. 83-1307). Alexandria, VA: Center for Naval Analyses.

Maier, M.H. & Truss, A.R. (1985). Validity of the Armed Services Vocational Aptitude Battery Forms 8, 9, and 10 with Applications to Forms 11, 12, 13, and 14. (CNR 102). Alexandria, VA: Center for Naval Analyses.

Maier, M. H. and Hirshfeld, S. F. Criterion Referenced Testing: A Large Scale Application. Technical Research Report 1193, Alexandria, Virginia: Army Research Institute, February 1978.

Maller, Charles; Kerachsky, Stuart; and Thornton, Craig. Evaluation of the Economic Impact of the Job Corps Program. Third Follow-up Report. Princeton, New Jersey: Mathematica Policy Research Inc., 1982.

Mangum, Steve, and Ball, David. "Military Service, Occupational Training and Labor Market Outcomes: An Update." Columbus: Center for Human Resource Research, The Ohio State University, March, 1986.

Markey, James and Parks, William. (1989) "Occupational Change: Pursuing a different kind of work." Monthly Labor Review, September, 3-12.

Mertens, Donna M.; McElwain, Douglas; Garcia, Conzalo and Whitmore, Mark. "The Effects of Participating In Vocational Education: Summary of Studies Reported Since 1968." Columbus: The National Center for Research in Vocational Education, The Ohio State University, May 1980.

Mertens, Donna M.; Seitz, Patricia and Cox, Sterling. "Vocational Education and The High School Dropout." Columbus: The National Center for Research in Vocational Education, The Ohio State University, September 1982.

Meyer, Robert. (1988) "The Effects of High School Academic Reforms on Course Enrollments and Academic Skills Growth: Evaluation and New Directions for Reform." Presented at Research Conference of the Association for Public Policy Analysis and Management, Oct. 29, 1988.

Meyer, R. "Job Training in the Schools." In Job Training for Youth, edited by R. Taylor, H. Rosen, and F. Pratzner. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Meyer, Robert. "Vocational Education: How Should It be Measured?" Cambridge, MA: Urban Institute, Harvard University, 1981.

Mikulecky, Larry. (1989) "Second Chance Basic Skills Programs." Investing in People; Background Papers. edited by David Crawford and Lauri Bassi, Vol. I. 187-214.

Mincer, Jacob (1989a) "Human Capital and the Labor Market: A Review of Current Research." Educational

Researcher. May 1989, 27-34.

Moore, Richard and Blake, David. (1992) Does ETP Training Work? An Analysis of the Economic Outcomes of California Employment Training Panel Programs. Northridge, Calif: California State University.

Mueser, Peter and Maloney, Tim. "Cognitive Ability, Human Capital and Employer Screening: Reconciling Labor Market Behavior with Studies of Employee Productivity." Department of Economics, U. of Missouri-Columbia, June 1987.

Murnane, Richard; Willett, John and Levy, Frank. "The Growing Importance of Cognitive Skills in Wage Determination." Graduate School of Education, Harvard University, 1992, 1-30.

National Assessment of Educational Progress. The Writing Report Card. Princeton, New Jersey: Educational Testing Service, 1986.

National Assessment of Educational Progress. The Mathematics Report Card. Princeton, New Jersey: Educational Testing Service, 1988.

National Center for Education Statistics, (1992a) The Condition of Eduction: 1992 (Washington, D.C.: Department of Education)

National Center for Education Statistics, (1992b) Digest of Education Statistics: 1992. Washington, D.C.: U.S. Department of Education, Table 352.

National Center for Education Statistics, (1993a) The Condition of Eduction: 1993 (Washington, D.C.: Department of Education)

National Center for Education Statistics, (1993b) Occupational and Educational Outcomes of Recent College Graduates 1 Year after Graduation: 1991 (Washington, D.C.: Department of Education)

National Commission on Excellence in Education. A Nation at Risk: The Imperative for Educational Reform. A report to the nation and the Secretary of Education. Washington, DC: Government Printing Office, April 1983.

National Council of Teachers of Mathematics. Curriculum Evaluation Standards for School Mathematics. Washington, DC: National Council of Teachers of Mathematics, 1989.

O'Boyle, Edward, "Job Tenure: How it Relates to Race and Age", Monthly Labor Review, January 1968, pg s 16-33.

Office of Technology Assessment. Worker Training: Competing in the New International Economy. OTA-ITE-457, (Washington, DC: U.S. Government Printing Office, September 1990b)

Olson, Craig A and Becker, Brian E. "A Proposed Technique for the Treatment of Restriction of Range in Selection Validation." Psychological Bulletin. Vol. 93, No 1, 1983, pp. 137-148.

Oppler, Scott H. and Peterson, Norman. 1992. "Comparing Validity Results using Project A Concurrent and Longitudinal Studies." presented at the 1992 convention of the American Psychological Association, Washington D.C. 1-32.

Osborn, W. C., Campbell, R. C., Ford, J. P., Hirshfeld, S. F., and Maier, M. H. Handbook for the Development of Skill Qualification Tests. Technical Report P-77-5. Alexandria, Virginia: Army Research Institute, November, 1977.

Parsons, Donald. "Wage Determination in the Post Training Period." Pathways to the Future, Vol. 7, Chapter 7, Center for Human Resource Research, Ohio State University, 1985.

Perry, Nancy J. "The New Improved Vocational School," Fortune, 6/19/89,PP. 127-138.

Powell, Arthur; Farrar, Eleanor and Cohen, David. The Shopping Mall High School. New York, New York: Houghton Mifflin, 1985

Pressey, Sidney, and Robinson, Francis. Psychology and New Education. (New York, Harper and Brothers Publication, 1944), p. 544.

Rasinski, Kenneth A. "The Effect of High School Vocational Education on Academic Achievement Gain and High School Persistence: Evidence from NELS:88." Chicago: National Opinion Research Corporation, May 1994.

Reilly, R. R., and Chao, G.T. "Validity and Fairness of Some Alternative Employee Selection Procedures." Personnel Psychology, 35 (1982):

Roper, John. "Technology Creates a New Physics Student," The Physics Teacher, January, 1989, pp. 26-28.

Rouse, Cecilia. (1993) "Democratization or Diversion? The Effect of Community Colleges on Educational Attainment." Working Paper # 313, Industrial Relations Section, Princeton University, Feb. 1993, 1-21.

Ruff, Richard D.; Lewis, Morgan V.; Orth, Mollie, N.; Shylo, Bruce J.; and Fraser, Jeannette L. "An Examination of the Desirability of Expanding Cooperative-Type Work Experience Efforts." Columbus: The National Center for Research in Vocational Education, The Ohio State University, January, 1982.

Rumberger, R. W. and Daymont, T. N., "The Impact of High School Curriculum on the Earnings and Employability of Youth." In Job Training for Youth, edited by R. Taylor, H. Rosen, and F. Pratzner. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Sekscenski, Edward S., "Job Tenure Declines as Work Force Changes", Monthly Labor Review, December 1979, pgs. 48-69.

Sims, W. H. and Hiatt, C. M., Validation of the Armed Services Vocational Aptitude Battery (ASVAB) Forms 6 and 7 with Applications to ASVAB Forms 8, 9, and 10. Marine Corps Operations Analysis Group, CNS 1160, Center for Naval Analysis, Alexandria, VA, 1981.

Soskice, David "The German Training System: Reconciling Markets and Institutions", Institute of Economic and Statistics, Oxford University, July 1991, pgs. 1-18.

Steedman, Hilary and Wagner, Karin, "Productivity, Machinery and Skills: Clothing Manufacture in Britain and Germany", National Institute Economic Review, May 1989, pgs. 40-57.

Steedman, Hilary, "Improvements in Workforce Qualifications: Britain and France 1979-88", National Institute Economic Review, August 1990, pgs. 50-61.

Steedman, Hilary and Wagner, Karin, "A Second Look at Productivity, Machinery and Skills in Britain and Germany", National Institute Economic Review, November 1987, Pgs. 84-94.

Steedman, Hilary, "Vocational Training in France and Britain: Office Work", National Institute Economic Review, May 1987, pgs. 58-70.

Sternberg, Robert J. The Triarchic Mind. New York: Penguin Books, 1988.

Thorndike, R. L. Personnel Selection: Test and Measurement Techniques. New York: Wiley, 1949.

U.S. Bureau of the Census, (1970). "Characteristics of Men with College Degrees: 1967." Current Population Reports, Population Characteristics, Series P20, No. 201, (p. 23) U.S. Government Printing Office, Washington, D.C. 1-34.

U.S. Bureau of the Census, (1987). "What's It Worth? Educational Background and Economic Status: Spring 1984." Current Population Reports, Series P-70, No. 11, U.S. Government Printing Office, Washington, D.C.

U.S. Bureau of the Census. Money Income of Households, Families and Persons in the United States: 1972. Current Population Reports, Series P60-184, U.S. Department of Commerce, September 1993.

U.S. Department of Defense. (1984a). Military-civilian occupational crosswalk manual.. Washington, DC: Office of the Assistant Secretary of Defense (Manpower, Installations and Logistics).

U.S. Military Entrance Processing Command. Counselor's Manual for the Armed Services Vocational Aptitude Battery, Form 14. July, 1984. DoD 1304.12X, U.S. Military Entrance Processing Command.

U.S. Bureau of Labor Statistics, "Sixty Percent of 1989 High School Graduates Enrolled in College", June 26, 1990.

U.S. Bureau of Labor Statistics, "Job Tenure", January 1987, pgs. 1-18.

U.S. Bureau of Labor Statistics, (1993) "Employer-Provided Training among Young Adults." Work and Family, February 1993, Report 838, 1-5.

Veum, Jonathan R. (1993a) "Training among Young Adults: Who, What Kind and for How Long?" Monthly Labor Review, August 1993, 27-32.

Veum, Jonathan R. (1993b) "Sources of Training and their Impact on Wages." Washington D.C.: U.S. Bureau of Labor Statistics, 1-27.

Vineberg, Robert and Joyner, John N. Prediction of Job Performance: Review of Military Studies. Alexandria, Va: Human Resources Organization, 1982a.

Vineberg, Robert and Joyner, John N. "Performance Measurement in the Military Services." Human Performance and Productivity, edited by Marvin Dunnette and Edwin Fleishman, (1982b), Hillsdale, NJ: Erlbaum. pp. 258-271.

Wagner, Jane. The Search for Signs of Intelligent Life in the Universe. New York: Harper and Row, 1986

Weber, Jim M. The Role of Vocational Education in Decreasing the Dropout Rate. Columbus, Ohio: The National Center for Research in Vocational Education, The Ohio State University, January, 1986.

Weiderhold-Fritz, Susanne. "Is There a Relationship between Cost of In-Company Vocational Training and the Offer of Training Places in the Federal Republic of Germany." Social Forces: Supplement on Youth Pay and Employers' Recruitment Practices for Young People in the Community, Commission of the European Communities, Directorate-Generale for Employment, Social Affairs and Education, 1985.

Wilbourn, J.M., Valentine, L.D., & Ree, M.J. (1984). Relationships of the Armed Services Vocational Aptitude

Battery (ASVAB) forms 8, 9, and 10 to Air Force technical school final grades (AFHRL-TP-84-08). Brooks Air Force Base, TX: Air Force Human Resources Laboratory.

Willis, Robert and Rosen, Sherwin. "Education and Self-Selection." Journal of Political Economy, 87, October 1979, pg. 57-536.

Wills, Joan. (1993) An Overview of Skill Standards Systems in Education and Industry. Washington, D.C.: The Institute for Educational Leadership.

ENDNOTES

1. The owners of small and medium sized businesses were surveyed in 1987. The 500,000 members of the National Federation of Independent Business (NFIB) were stratified by employment and large firms over sampled. Salaried managers in charge of subunits of large publicly owned corporations are not eligible for membership in NFIB, so the samplé does not contain data on employment outcomes at large multi-establishment firms. A four page questionnaire was mailed to approximately 11,000 firms, and after 3 follow up waves, 2599 response were obtained. Business owners with no employees in the previous year or who had not hired anyone in the last three years, were asked to check a box and send the questionnaire back completely blank. Five hundred and sixty nine of the returned questionnaires were of this type. The survey focused on a single job--the job "for which...you hired the most people over the last two or three years."

2. Employers believe they are more able to accurately assess basic skills prior to hiring than other traits such as learning ability and good work habits. Basic skills are positively correlated with these other abilities, so employers sometimes use basic skills assessments as an indicator of these other traits. This may be one of the reasons why measures of basic skills are highly correlated with wages and earnings of adults, even though employers say they do not give high priority to reading, writing and mathematics in hiring.

3. After a series of general questions about the character of the job and the worker qualities that were sought when filling that job, the manager was asked to select two individuals who had been hired for this job and answer all future questions specifically with reference to those two workers. The selection was made in response to the following question:

> "Please think of the last person hired for this job (job X) by your firm **prior** to August 1986 **regardless of whether that person is still employed by your firm.** Call this individual person A. The individual hired for job X immediately before person A is called person B. Do not include rehires of former employees." Information of varying degrees of completeness was obtained on 1624 person A's and 1403 person B's.

4. How can these last two findings be explained? Employers typically hire workers with no relevant work experience only when they expect them to be fast learners. These workers are typically less productive at first and improve rapidly sometimes catching up with more experienced workers after a year or so on the job. Nevertheless, their lack of previous experience means they are less productive at first, must be given extra training and, therefore, must typically accept lower initial wage rates. The negative relationship between work habits and wage rates is harder to explain. It is very difficult to predict which job applicant will have the best work habits, so the starting wage seldom reflects later judgements about the work habits. After a year or so on the job, the owner will have a reasonably well informed opinion about their employee's work habits, but adjustments in relative wages to differences in productivity are slow and incomplete (Bishop 1989). The new hire whose work habits are perceived as 'much better' and is judged to be 20 percent more productive as a result is offered a larger than average wage increase but since she started at a lower wage she remains under paid.

5. Since occupational experience rises as tenure increases, the total effect of tenure is the sum of the tenure effects in row 9 of table C1 of Bishop (1993a) and the occupational experience effect in row 7. Age is treated as fixed.

6. Average compensation of operative, laborer, craft and technical workers was assumed to be $35,969 in 1993. Present discounted value at age 18 is calculated assuming continuous employment from age 18 to 65 using the formula: $[1-(1-r)^{7}]/r$ where $r = .05$.

7. Two dimensions of mathematical achievement were measured: the speed of doing simple mathematical computations is measured by a three minute 50 problem arithmetic computation subtest which will be referred to as computational speed. Computational speed has only small effects on SQTs. Mathematical reasoning ability was measured by a composite of the mathematics knowledge and arithmetic reasoning subtests.

8. Because of the concurrent design, the control variables may have been influenced by army experiences so M2 results exaggerate the impact of the new cognitive and non-cognitive variables and underestimate the effect of the ASVAB composites. A validation study using a prospective design confirms this. In longitudinal data where predictor constructs were measured early in the individual's first tour prior to measurement of the criterion constructs, multiple partial Rs are considerably higher for ASVAB composites and other cognitive variables but considerably lower for the dependability and achievement/surgency temperament constructs (Oppler and Peterson 1992).

9. Technical and academic competencies were assumed to have linear and additive effects on labor market outcomes:

(1) $\underline{Y}_t = \underline{a}\underline{A} + b_t C + c_t T + e_t S + \underline{g}\underline{Z}_t + \underline{u}$ for t = 1983...1986

where $\underline{Y}_t$ is a vector of labor market outcomes (wage rates and earnings) for year t.

$\underline{A}$ is a vector of test scores measuring competence in mathematical reasoning, reading and vocabulary and science knowledge.

C is a measure of speed in simple arithmetic computation.

T is the technical composite measuring mechanical comprehension and electronics, auto and shop knowledge.

S is clerical checking speed.

$\underline{Z}_t$ is a vector of control variables such as age, age squared, schooling, school attendance, minority status, region, residence in an SMSA and local unemployment rate.

$\underline{u}$ is a vector of disturbance terms for each year.

10. Bishop, Blakemore and Low's (1985) studied the effect of math, reading and vocabulary test scores on the wage rates and earnings of high school graduates for both 1972 and 1980 in a model that contained controls for grade point average and the number of credit hours of academic and vocational courses. In both these years, none of the variables representing academic performance--the three test scores, GPA and the number of academic courses--had a significant (at the ten percent level) effect on the wage rate of the first post high school job. Only one variable (the vocabulary test for female members of the class of 1972) had a significant effect on the wage 18 months after graduation.

11. Worker risk aversion results in employment contracts which adjust wages only partially with differentials in productivity between workers. Workers who screw up do not suffer the full costs of their mistake and those who make outstanding contributions do not receive 100 percent of the benefits they generate. Training investments are risky and employers are better informed about which skills will raise a worker's productivity (in part because they control the work environment which determines whether a skill yields productivity improvements) and are better able to bear the risks of making a mistake.

12. If training an employee causes a reduction in output or necessitates an increase in hours paid, profits and thus taxes are reduced. If workers pay for training by accepting lower wage jobs, individual income tax payments are reduced. In both of these cases, training costs are effectively deductible in the year they are incurred. If all individuals pay taxes every year at the same marginal tax rate, the tax system

12. If training an employee causes a reduction in output or necessitates an increase in hours paid, profits and thus taxes are reduced. If workers pay for training by accepting lower wage jobs, individual income tax payments are reduced. In both of these cases, training costs are effectively deductible in the year they are incurred. If all individuals pay taxes every year at the same marginal tax rate, the tax system would not distort decisions to invest in OJT. In fact, however, some training costs are not deductible and tax rates are generally higher when benefits are being received than when costs are being incurred, so the tax system discourages training investments.

13. Prior to 1981 CPS respondents were asked, "When did ...start working at his present job or business?" Starting in 1983 the wording was "How long has... been working continuously for the present employer (or as self-employed)?" This change in wording has increased reported tenure because prior to 1981 some respondents reported job changes when they were promoted to higher level positions at the company. Now the CPS supplement has a separate question on occupational tenure.

14. In 1991 the first year salaries of BAs in engineering and computer science were 41 percent above the average for all BAs. Humanities BAs were paid 14 percent below average (NCES 1993).

15. Users of old versions of an applications program (such as Excel) account for the majority of purchasers of updated versions. To accommodate these users, new versions retain compatibility with and the same look and feel of earlier releases of the software. Competitors trying to steal customers away from the industry leader try to copy the look and feel of the most popular program in the category.

16. The BLS projects that managerial, professional and technical jobs will account for 40.9 percent of job growth to the year 2005 (Silvestri and Lukasiewicz 1991). However, the BLS method of projecting occupational changes has consistently under predicted the growth of managerial and professional jobs. They start with an assumption--the occupational composition of employment in individual industries will not be radically different in the year 2005--that is manifestly wrong. A few *ad hoc* adjustments are made to the occupational compositions projections for 2005, but most of these parameters are taken as fixed. This results in a substantial understatement of upskilling trends. In 1981 the BLS projected that professional, technical and managerial jobs would account for 28 percent of employment growth between 1978 and 1990. Data from the Current Population Survey indicate that these occupations, in fact, accounted for 53.6 percent of 1978-90 job growth.

17. In my judgement Kulik's estimate that 80 percent of the gap between vocational and academic students is self selection is probably too low. Many of the regression studies presented in Table 6 included lagged test scores on the right hand side of the model. These indicators of early ability are measured with a good deal of error. When critical control variables are measured with error, all coefficients in the model are biased not just the coefficients on the control variables. Meyer (1988) has shown that when the beginning test score is included as a right hand side regressor in models predicting test score gains (or lagged test scores included in models predicting end of high school levels of test scores), that estimated impacts of vocational education are seriously biased in a negative direction. Using an instrumental variable technique, he shows that in HSB data the correct coefficient on the lagged test score is approximately one when the end of high school level of test scores is the dependent variable.

18. The specific model estimated was:

(2) $Y_{it} - Y_{it-1} = \beta X_{it-1} + \phi C + \theta Y_{j \neq i,t-1} \qquad i = 1....5$

where

Y_{it} = the i th outcome variable measured at the end of senior year. (e.g. math test score)

Y_{it-1} = the sophomore year measure of the i th outcome variable

$Y_{j=i,t1}$ = a vector of sophomore year measures of outcome variables other than the i th

X_{t1} = a vector of variables characterizing background and curriculum course-work variables measured in the sophomore year

C = a vector of variables describing the courses taken in junior and senior year

ϕ = a vector of coefficients measuring effects of course work on learning and career aspirations

The control variables included an array of socioeconomic background variables, sophomore year GPA, sophomore year test scores, sophomore year attitudinal variables, sophomore year educational and occupational expectations, and the parents' career expectations for their child.

19. The model specification is given below:

(3) $\Delta R_{jk} = \beta_0 + \underline{\beta}_k(\underline{X}_A - \underline{X}_B) + (u_{Aj} - u_{Bj})$

where person A and B both work in the same job "j".

ΔR_{jk} = a ranking of employee A relative to B on the "k" th ability dimension. (It ranges from + 2 when person A is "much better" to -2 when person B is "much better."

$\underline{X}_i$ = a vector of background characteristics of person "i" including years of schooling, years of relevant vocational schooling, years of relevant work experience, age, gender and ethnicity.

u_{ij} = a random error that is specific to the match between person and the job.

Estimating this model produces unbiased estimates of $\underline{\beta}_k$ if the X_i's are not correlated with the u_{ij}'s.

20. The purpose is not to estimate the structural relationship between indicators of skill and job performance so that we may predict the performance of prospective new hires. The unknown character of the selection process by which job applicants are selected for and retained in jobs makes unbiased estimates of structural relationships impossible. We are examining instead what kind of relationship between personal characteristics and productivity survives the selection process which determines who gets hired and who is retained in a job. Employees with equal tenure in a job are not always paid the same wage, particularly at small firms. In the EOPP-NCRVE employer survey--a sample dominated by small establishments--the standard deviation of the log of the wage paid to incumbents in a particular job was 0.146. Variation in the wage paid for particular jobs accounted for 4 percent of the total variation of starting wage rates in the sample and 5 percent of the variation in the current wage rates of job incumbents. When firms offer different wage rates to different hires, a perfectly competitive labor market is quite consistent with substantial differences in the expected productivity, training requirements or turnover rates of new employees hired for a specific job. To assess how differences in productivity and wage rates vary with previous training and experience, I estimate equation (4).

(4) $Y_{1jk} - Y_{2jk} = \underline{\beta}'_k(\underline{X}_1 - \underline{X}_2) + \underline{\beta}_k(\underline{S}_{1j} - \underline{S}_{2j}) + (u_{1jk} - u_{2jk})$

where person 1 and 2 both work in the same job "j" and matched pairs of new hires for each job "j" are the data. Estimating this model produces unbiased estimates of $\underline{\beta}'_k$ and $\underline{\beta}_k$ if the X_i's and the $\underline{S}_{ij}$'s are not correlated with the u_{ijk}'s.

Y_{ijk} is the 'k'th outcome of the match between employee "i" and job "j." The outcomes being modeled include turnover, wage rate, and supervisor reports of the worker's productivity.

$\underline{X}_i$ is a vector of background characteristics of individual "i".

$\underline{S}_{ij}$ is a vector of characteristics of individual "i" describing previous training that effects performance in job "j."

u_{ijk} is a random error that is specific to the match between individual and the job

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21. The data is from the 2nd wave of the EOPP Employer Survey sponsored by the National Center for Research in Vocational Education. The Gallup Organization conducted the phone interviews between February and June 1982. Firms hiring low wage workers were over sampled. The employers were asked to select "the last new employee your company hired prior to August 1981 regardless of whether that person is still employed by your company." The study examined 2594 employers who had hired someone in the time frame requested. Seventy percent of the establishments had fewer than 50 employees, and only 12 percent had more than 200 employees. Most respondents were, thus, owners or managers of small firms who were quite familiar with the performance of each of the firm's employees. If the primary respondent was unable to answer questions about the training received by a specific newly hired worker, that part of the interview was completed by talking to a supervisor or someone else with line responsibility. For that new hire, the employer was asked to estimate how much time was "spent" in the first three months on four different kinds of training activities: (1) "formal training such as self-paced learning programs or training done by specialized training personnel", (2) "training activities in which he or she is watching others do the job rather than doing it himself", (3) "total number of hours management and line supervisors spent away from other activities giving informal individualized training or extra supervision", and (4) total number of hours co-workers who are not supervisors spent away from their normal work giving informal individualized training or extra supervision."

22. The estimate of training investment is the mean wage for occupants of the job at the time of the interview times the "training time index." This index was constructed by first valuing trainer and trainee time relative to that of workers with two years of tenure in that job and then combining the time invested in training activities during the first three months on the job. The employers reported that workers with two years of tenure in the job averaged between 22 and 50 percent (depending on occupation and other worker characteristics) more productive than new hires during their first three months on the job. This ratio was calculated for each job/worker category and used to place a relative value on coworker time devoted to training. The management staff members who provide formal and informal training were assumed to be paid 1.5 times the wage of coworkers. Formal training involves four kinds of costs: development costs, facility costs, trainer time and trainee time. Sometimes, it is one-on-one and sometimes it is done in groups but since most of the establishments in this study are small, class size was probably small as well. Consequently, it was assumed that when all the costs of formal training other than the trainee's time are lumped together--development costs, training materials costs and the value of the trainer's time--they are about 25 percent greater than the time costs of the trainee. When supervisors and coworkers were giving informal training to new employees, the trainee was almost invariably directly involved in a production activity. Employers report that during informal training, the trainees were typically just as productive while being trained as they were when working alone (Hollenbeck and Smith 1984). Consequently, informal training was assumed to involve only the investment of the trainer's time. Thus in units of coworker time the value of trainer time was:

(5) Valued Trainer Time = $T_C + 1.5{*}T_S + T_F$

In units of trainee time, the time the trainee spends not producing because of training activities was:

(6) Trainee Time = $T_W + T_F$ (2)

The total investment in training in trainee time units is:

(7) Total Training Investment = $T_W + T_F + (T_C + 1.5{*}T_S + T_F)/RP.$ (3)

where RP = the productivity of the average new hire during the first 3 months divided by the productivity of typical worker with two years' tenure

The arithmetic mean of this index was 209 hours, implying that the value of the time invested in training a typical new employee in the first three months was about 40 percent of the output that the trainee can produce working full-time during the first three months on the job.

23. The data used here is an average of earnings ratios for 1984, 1987 and 1990 (U.S. Bureau of the Census 1987, Kominski 1990, Kominski and Sutterlin 1992). The very large differentials between college majors found in these data reflect both differences in wage rates and in hours worked per month. If gender were controlled, the differentials would be smaller.

24. Selection effects might be contributing to the large estimated effects of employer sponsored training. If employers identify talent by observing past job performance and then select the top performers for training, promotions and wage increases, the association between training receipt (not quantity) and wage increases might not reflect a causal effect of training on productivity, so much as a decision to reward the worker's past contributions to the firm. If this is what is happening, OLS coefficients would over estimate the effect of training on wage rates. Veum included selection correction terms in his model to deal with this problem. While the coefficient on the selection correction for company training was negative as hypothesized, it was not statistically significant and the corrected estimate of the impact of company training remained quite large. Another way to examine the issue of causality in the wage growth equation is to examine productivity growth. Is it really true that top performers get more training, or do they get less because they learned the job more quickly? If less competent workers must receive more training, that might explain why it is receipt not the quantity of training that explains wage growth.

25. The occupation of the current or most recent job is matched against field of training to define training relatedness. One has to be in the labor force at least one week during the year to be in a training related job, so the association between the two reflects both directions of causation. Since almost all individuals in the sample had been in at least one job since completing school, this is not likely to be a serious source of bias.

26. The analysis makes use of data on 550 pairs of recently hired workers employed in the same or a very similar job at 550 different firms. The following model was estimated:

(8) $Y_1 - Y_2 = A (D_1 - D_2) + B (X_1 - X_2)$

where $Y_1 - Y_2$ = is the difference between the productivity or required training of person 1 and 2

D_1, D_2 = A dummy indicating that person 1 or 2 had obtained vocational training from a school that was relevant to the job for which he/she was hired

X_1, X_2 = A vector of control variables for the circumstances of the hire, and the new hires other credentials. When current productivity is Y, tenure squared are included in the X's.

27. When a less rigorous definition of training relatedness is used (e.g. one based on questions like "On your present job, how much do you use the vocational training you received in high school or area vocational center?" Bice and Brown, 1973), more than half of vocational graduates report using their training. This implies that a substantial minority of vocational graduates report making some use of their vocational education even though there is no match between their occupation and their training. The Campbell et al., (1986) study implies that the amount of carryover is probably quite small, for these graduates were treated as having an unrelated job and the overall wage impact of vocational education for those with an unrelated job was close to zero.

28. The Campbell et al., (1986) study implies, however, that the amount of carryover is probably small, for these graduates were treated as having an unrelated job and the overall wage impact of vocational education for those with an unrelated job was close to zero.

29. The U.S. rate of training related placement might have been somewhat higher if measured 6 months after high school graduation. However the German definitions of relatedness are more rigorous and applying them to U.S. data would have lowered training related placement rates. High unemployment rates no doubt contribute to the low rates of training related placement in the U.S. However, aggregate differential between the countries in training related placement cannot be attributed to differentials in the general tightness of labor markets.

30. If asked by someone other than the employer, some school officials might have defended their policy on the grounds that poor students will not be considered if an employer learns of this fact. What they don't realize is that the policy results in no recent graduates (whether good or poor student) getting a job that pays well and offers opportunities for training and promotions. In effect they are saying the interests of the students who do not study and are discipline problems should take precedence over the interests of the students who lived by the schools rules and studied hard. There is nothing unfair about letting high school GPA's influence the allocation of young people to the best jobs. The GPA's are an average which reflects performance on 100's of tests, and the evaluations of over 20 teachers each of which is based on over 180 days of interaction. Selection decisions must be made somehow. If measures of performance in school are not available, the hiring selection will be determined by the chemistry of a job interview and idiosyncratic recommendations of a single previous employer. Since many employers will not request the information, providing information on student performance does not prevent the poorer student from getting a job; it only influences the quality of the job that the student is able to get.

31. This statement is subject to the following caveat. There are many differences across individuals and vocational programs in the marginal payoff to vocational course work that could not be incorporated in the models estimated by Kang and Bishop (1989). If such differences are visible to individual students and teachers and they have confidence in their local information, they should base decisions on the local information even though it may contradict one of the generalizations just made.

32. These results come from estimating the regression models described in footnote 12.

33. Moore and Blake, 1992. The ETP has funded two evaluations of itself focusing on earnings impacts. These studies, however, used a seriously flawed before-after methodology which greatly exaggerates the effect of the program. Neither used random assignment. In the most recent study the main focus was on a comparison of earnings gains for completers (those who complete the training and are retained by the employer for at least 3 months) to the gains for dropouts (those who quit or are laid off or fired within three months of initiating training). For incumbent workers involved in retraining, the difference was 14 percent. This is not, however, an estimate of the effect of training. It is an estimate of the effect of turnover.

35. Reliability is important because it is anticipated that career choices (classification outcomes) will be influenced by exam results. School exams may also be more valid because they are not limited to the multiple choice format.

35. On the criterion referenced NAEP mathematics scale, 15 percent of 13 year olds have better mathematics skills than the average 17 year old student, and 7 percent of 13 year olds score below the average 9 year old (NAEP 1988b). On the criterion referenced NAEP reading scale, 16.5 percent of 13 year olds have better reading skills than the average 17 year old student, and 9 percent of 13 year olds score below the average 9 year old (NAEP 1986). The variance of achievement at age 13 is roughly comparable abroad (Lapointe, Mead and Askew 1992). If by some magic we were able to cut the variance of achievement in half, variability would still be huge: 15-16 percent of 13 year olds would perform better than the average 16 year old and 7 to 9 percent would perform below the average 10 year old. Consequently, it is neither feasible nor desirable for all senior high school students to pursue the same curriculum. While many nations have a common curriculum with no tracking in elementary

school and lower secondary schools, no country requires all senior secondary students to take the same courses. Some students will want to pursue subjects like mathematics and science in greater depth and rigor than others. Some students will want to concentrate on technology not pure science. Some courses will be easier than others and students will inevitably be able to choose between more demanding and less demanding courses. Tracking is not the cause of the low American achievement levels. Slavin's (1988) review of the literature on tracking in secondary school found no effects on mean achievement levels. The Asian and European systems, that get most of their students to achieve at high levels, have more pervasive tracking systems than the U.S. What is distinctive about American schools is the lack of clarity about which track/program you are in and the consequent lack of rewards for pursuing a more demanding educational program.

36. This argument does not apply to federal subsidies of the development of skill standards and occupational competency assessments by industry groups. Occupations do not vary enough across state lines to require separate competency assessment systems in each state. In Germany, for example, the *Lander's* are responsible for academic and school based components of K-12 schooling, but the federal government handles governmental oversight and subsidy of the apprenticeship system. The curriculum frameworks and the skills that will be assessed in the final examinations are agreed upon by committees made up of people from the industry concerned. The practical component of the exam is judged locally but the written sections of the final exams are often the same across the nation. Because of the high geographic mobility of labor in the U.S. business will probably prefer that skill standards and assessment be handled nationally by the industry, not by state governments. States would then decide whether to use the industry developed skill standards and assessments in their community colleges and the other occupational training programs they run.

37. According to the National Assessment of Educational Progress (1988), 93 percent of 17 year olds do not have "the capacity to apply mathematical operations in a variety of problem settings (p. 42)." "In persuasive writing, students had difficulty providing evidence for their points of view....Even in 11th grade, only 28 percent wrote **adequate** or **elaborated** responses to the least difficult persuasive task (1986, p. 9). The 25 percent of the Canadian 18 year olds studying chemistry know as much chemistry as the top 1 percent of American high school graduates taking their second year of chemistry, most of whom are in Advanced Placement classes (International Association for the Evaluation of Educational Achievement, 1988).

38. In 1985 the mean full time compensation of operatives, craft workers and technicians was approximately $25,000 a year. Studies that measure output for different workers in the same job at the same firm, using physical output as a criterion, can be manipulated to produce estimates of the standard deviation of non-transitory output variation across individuals. It averages about .14 in operative jobs, .28 in craft jobs, .34 in technician jobs, .164 in routine clerical jobs and .278 in clerical jobs with decision making responsibilities (Hunter, Schmidt & Judiesch 1988). Because there are fixed costs to employing an individual (facilities, equipment, light, heat and overhead functions such as hiring and payrolling), the coefficient of variation of marginal products of individuals is assumed to be 1.5 times the coefficient of variation of productivity. Because about 2/3rds of clerical jobs can be classified as routine, the coefficient of variation of marginal productivity for clerical jobs is 30 % [1.5*(.33*.278+.67*.164)]. Averaging operative jobs in with craft and technical jobs produces a similar 30% figure for blue collar jobs. The details and rationale of these calculations are explained in Bishop 1988b.

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